OCTOBER
1949

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

HIGHER PRODUCTIVITY AND LOWER COSTS FOR CHEMICAL PROCESS INDUSTRIES IS THIS MONTH'S REPORT SUBJECT

A McGraw-Hill Publication *Fifty Cents*

TUBE-TURN

tt

WELDING FITTINGS AND FLANGES

18-inch standard weight Tube-Turn welding tee and pipe laid out preparatory to assembly for hydrostatic pressure test.

Welder completing last bead in assembly. Fitting and pipe now form homogeneous, leakproof unit.

Assembly is hung in pit, massively lined with concrete. During test top grating is closed and held down by a barricade of sandbags.

Final result after hydrostatic pressure test. The straight pipe burst first, and the tee is undamaged.

Strength through Design in Tube-Turn welding fittings

The pipe burst first!

Tube-Turn "barrel-shaped" welding tee.

Take an 18-inch standard weight welding tee. Take three corresponding lengths of pipe. Weld tee and pipe together. Cap the ends. Lower the assembly into a pit. Then apply hydrostatic pressure—much more than the assembly is supposed to take!

Something has to give! According to the accepted beliefs it should be the tee. But not in the case of the test pictured here. The Tube-Turn "barrel-shaped" tee was used—and the pipe burst, well before the tee was affected! Throughout numerous tests, this new type of tee has withstood at least 25 per cent more pressure than required by the formula given in ASA B16.9.

The superior strength of the tee was achieved without running up extra weight and cost, by carefully planned improvements in shape (based on the sphere, nature's strongest form for internal pressure), and by a carefully engineered distribution of metal.

This is a typical example of *strength through design* in Tube-Turn welding fittings, and another good reason why leading piping engineers specify Tube-Turn equipped, welded piping.

TUBE TURNS, INC.

238 East Broadway, Dept. J, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

OCTOBER 1949

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

THIS MONTH

EVERY MONTH

An index to advertisers will be found on the fifth page preceding the back cover

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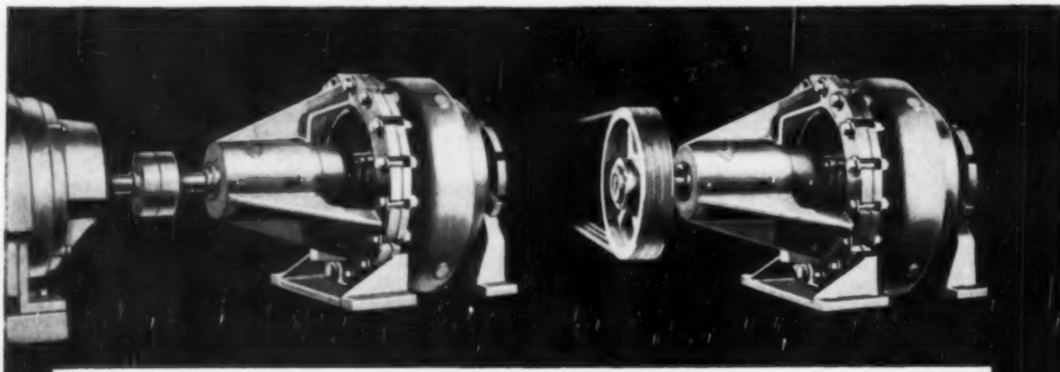
Member ABP; Member ABC

Solve Fluid Flow

WITH THESE ALLIS-



These Solids Pumps Look Alike, but...

THE "PW" IS FOR *CORROSIVE* FLUIDS

Working parts of direct-driven PW solids pump are made of special alloys designed for maximum resistance to *corrosion*. These Allis-Chalmers pumps handle a wide range of chemical pulps and liquors with negligible dilution from sealing water.

- **Has special corrosion-resistant alloy parts.**
- **Designed for direct-drive, motor or engine.**
- **Handles up to 40% solids in suspension.**
- **Only 5 major parts — high accessibility.**
- **175 to 8,000 gpm; heads to 140 ft.**

Send for Bulletin 08B7112.

THE "CW" IS FOR *ABRASIVE* FLUIDS

Working parts of CW solids pump are made of *Allisite* alloy, an extremely hard, non-machinable alloy that offers remarkable resistance to *abrasion*. Effective in handling slurries, tailings, sludges. Delivers near-rated capacity until parts are completely worn out.

- **Has hard *Allisite* alloy working parts.**
- **Driven through Texrope V-belt drive and motor.**
- **Also handles up to 40% solids.**
- **Parts accessible without disturbing piping.**
- **175 to 8,000 gpm; heads to 140 ft.**

Send for Bulletin 08B6381B.

PROFITABLE SOLUTIONS to your fluid handling problems depend on getting the *right* pumps specified for your job in the first place. Then your pumps will deliver rated capacity month after month . . . and you'll have better control of your fluid flow operations.

Insist on getting top value in terms of durability when buying pumps. The centrifugal pumps shown here are excellent examples of sound pump design . . . with strength features that "pay off" in long, reliable service.

Another important thing — get pumps that are easy to install and maintain. Here too, you'll find Allis-Chalmers offers pumps designed for ease of packing . . . ease of disassembly . . . ease of replacing standard parts.

Find out more about this modern pump line from the A-C representative in your area.

This AO Acetate Safety Goggle

GIVES CHEMICAL WORKERS SPARKLESS PROTECTION AGAINST FLYING PARTICLES

QUICK FACTS

*6 Curve Super Armorplate lenses, Clear or Calobar in 3 shades.

*Acetate side shields, perforated to minimize fogging of lenses and for ample ventilation.

*Lightweight strong keyhole bridge.

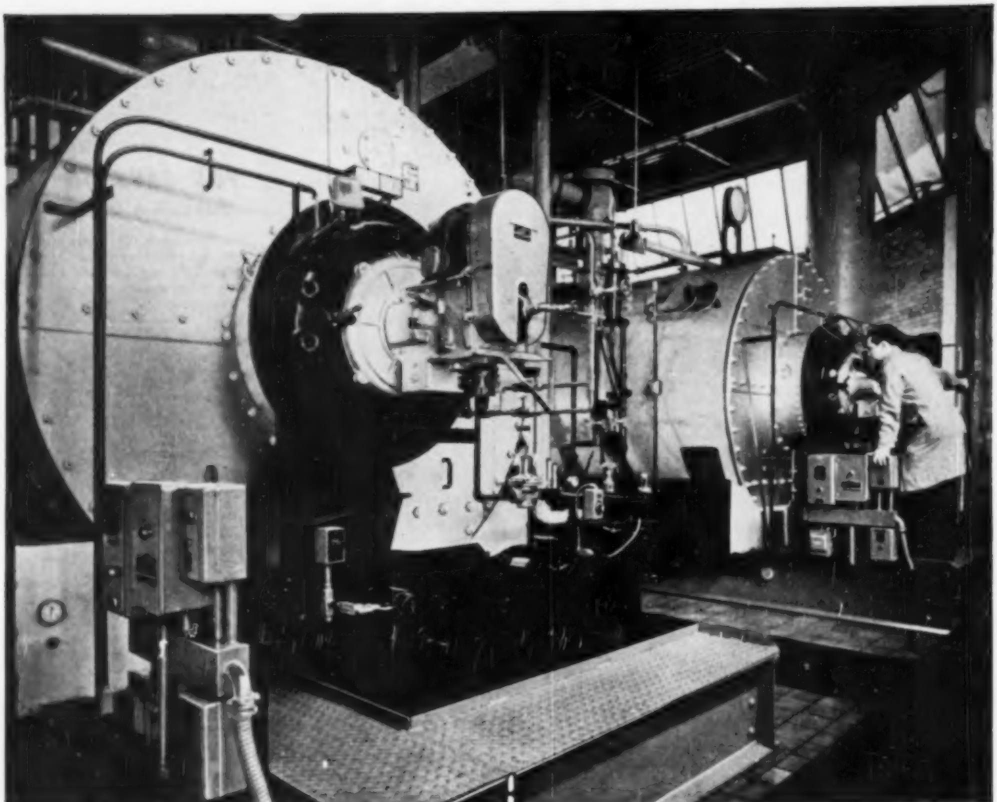
*Hinges and temples out of line of sight.

*Nose pads distribute goggle weight evenly for comfort.

It's good looking. It's light. It's strong and durable. And *important to chemical workers*, sparks due to flying particles can't endanger because the frame of the AO 9249 is made of nonflammable cellulose acetate. Call your nearest AO Safety Products Representative or write.

American Optical
SAFETY PRODUCTS DIVISION

Southbridge, Massachusetts • Branches in Principal Cities



Never *Forget*

BOILERS BURN DOLLARS . . .

Yes — generating steam costs money — money for fuel, boiler operation, care and maintenance. An old or outmoded fuel-wasting boiler can burn many hidden dollars through excessively high steam costs.

It's sound business to install boilers that give you the most for your steam dollars — modern, guaranteed high efficiency Cleaver-Brooks boilers, using oil or gas as fuel.

For any boiler installation (15 to 500 HP.)—new or replacement—Cleaver-Brooks offers these immediate and long-range cost-saving advantages:

A Custom-Planned Boiler Engineered for Your Needs: Your steam needs and steam-using equipment are studied — your present steam load plus your estimate of future expansion are considered — with this information the size of Cleaver-Brooks Boiler best suited to your specific needs is determined.

Factory Starting Service: Your boiler is placed in operation by Cleaver-Brooks factory service-engineers. Your operators are trained in operation, care and maintenance.

Flexible Operation Burning Gas or Oil With Equal Efficiency: You can use oil, gas, or combination oil and gas, whichever is of lower cost. Through their high heat transfer, Cleaver-Brooks boilers operate at a guaranteed efficiency of 80% from full load down to 30% of rating.

In addition, Cleaver-Brooks boilers give you clean, smokeless operation — eliminate fuel and ash handling — require no high or costly stacks — no special foundations — fit under low headroom — provide quick steaming, flexible operation to meet fluctuating loads — fully meet all codes.

Available in sizes 15 to 500 HP., 15 to 200 P.S.I. — write for Cleaver-Brooks steam boiler bulletin.

CLEAVER-BROOKS COMPANY
339 E. Keefe Ave., Milwaukee 12, Wis.

WRITE on your business letterhead for Steam Cost Calculator—

a ready reference slide rule showing comparative steam costs when using oil, gas, or coal as fuel. Mailed on request — no obligation.

Cleaver-Brooks
STEAM BOILERS

TOMORROW'S RECTIFIER STATION

● Here it is! — the first functionally planned rectifier station . . . a complete installation built around I-T-E's new Mechanical Rectifier!

This equipment is now being built at I-T-E. When completed, the installation will consist of two rectifier stations, each delivering 24,000 amperes — one at 200 volts, and the other at 325 volts.

NOTE THE MANY FEATURES OF THIS MODERN STATION:

The centrally located operating room contains all necessary controls — makes for efficient operating procedures. All equipment for the operation of the entire station is within easy and immediate reach of the operator.

Drawout-type a-c protective switchgear is also in the central location, convenient to the rectifier control board.

I-T-E Mechanical Rectifiers and the controls for individual units are completely enclosed in metal.

The overhead bus carrying the d-c power from the rectifier to the d-c switchgear is completely metal-enclosed.

NOTE THAT IT WAS NOT NECESSARY TO PROVIDE OVERHEAD CRANE SPACE:

I-T-E Mechanical Rectifiers can be moved easily and quickly on their own wheels, as can the I-T-E a-c and d-c drawout breakers. *Complete mobility* of I-T-E units eliminates the need for overhead crane facilities and makes it possible to use the space for bus runs.

The I-T-E equipment for this station will be delivered to the installation site as packaged units — completely assembled, wired, tested, and ready to connect!

Get the complete story . . .

I-T-E Bulletin 4809 contains complete technical information on the I-T-E Mechanical Rectifier, as well as a detailed presentation of its operating principles. Send for it today!

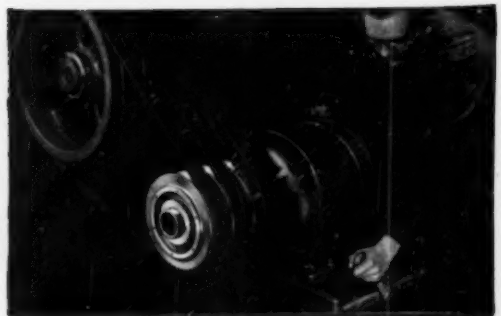
MECHANICAL RECTIFIERS

I-T-E Circuit Breaker Company
19th & Hamilton Streets, Philadelphia 30, Pa.

31 Offices in United States • In Canada, EASTERN POWER DEVICES LTD., Toronto • For Export: Phillips Export Corp., New York

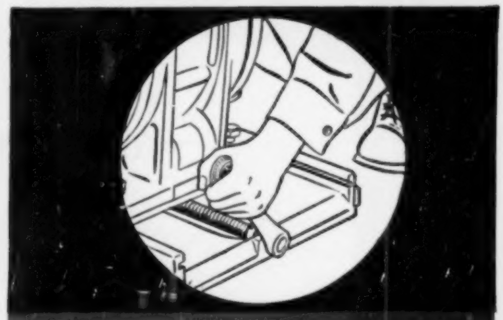
SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

Vari-Pitch AUTOMATIC SHEAVE



TO GO FASTER—

TO GO SLOWER—



ONE HAND DOES IT—

TEXROPE *offers Instant, Low Cost Way to*

Control Machine Speed

- Covers most speed changing applications from 1½ to 40 hp.
- Very simple — one sheave does everything automatically.
- Infinitely variable speed—100% increase; 2 to 1 range.

NOW YOU CAN HAVE all the advantages of instant speed control on all your machines at very low cost and without installing intricate and expensive mechanisms. You can increase production by setting operating speeds at exactly the right tempo for highest production. You can improve quality, change to new materials, all at the twist of a wrist.

All this is made possible by the *new Vari-Pitch* Automatic Sheave which changes pitch diameter and holds proper belt tension *automatically*. Today, ask your A-C Authorized Dealer or Sales Office to give you complete facts and figures on how the new *Vari-Pitch* Automatic Sheave can save money in your operations. Or write for Bulletin 20B7223. A-2837

ALLIS-CHALMERS, 1147A SO. 70 ST.
MILWAUKEE, WIS.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

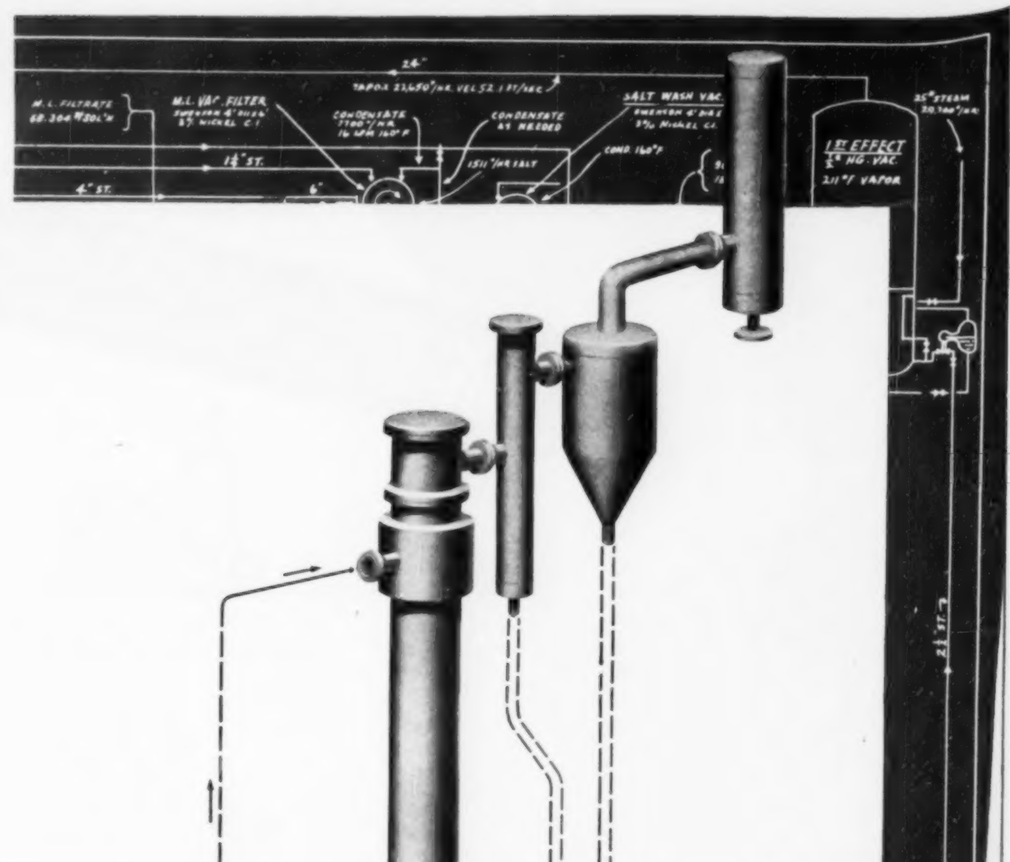
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

ALLIS-CHALMERS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FEED
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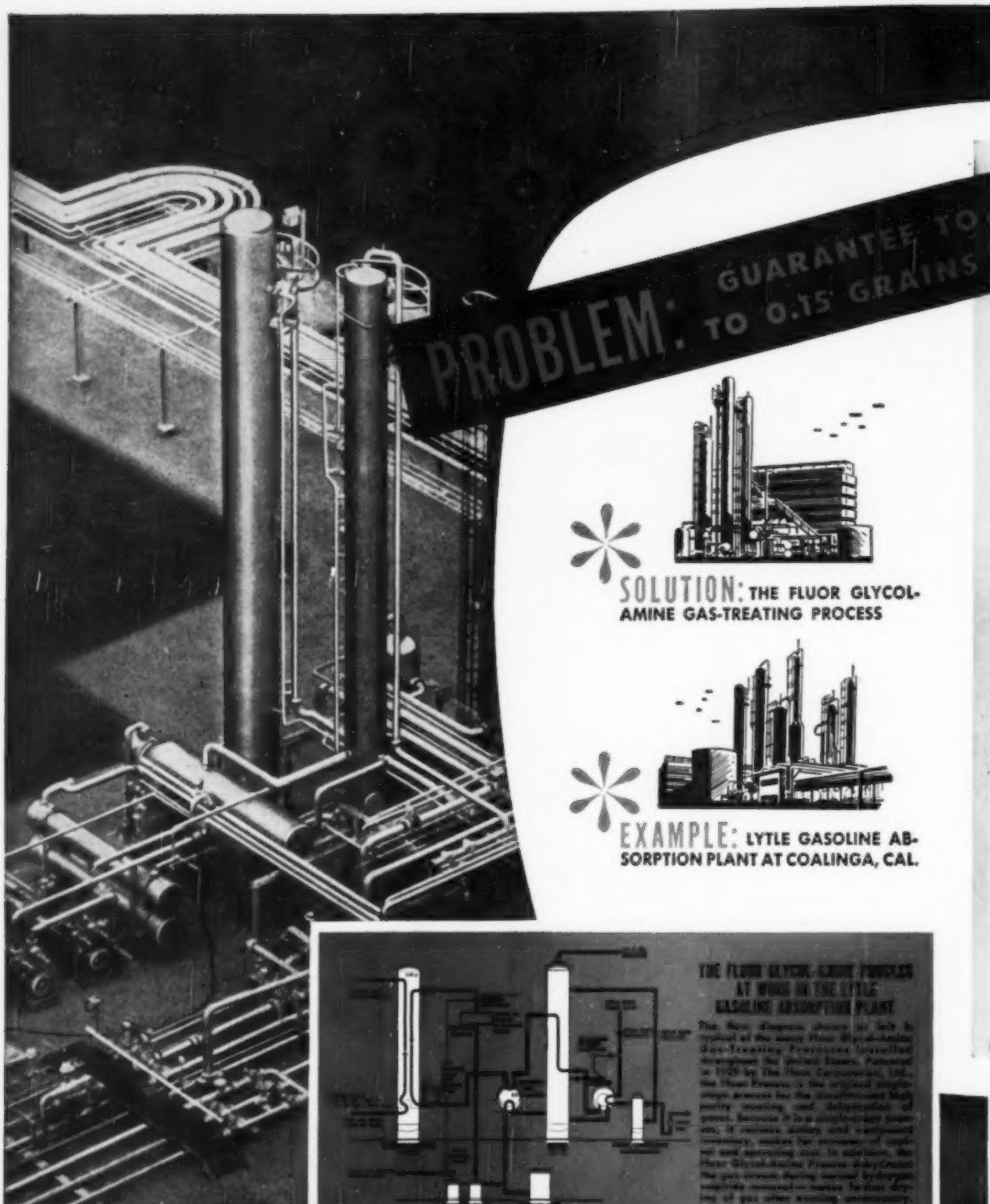
EVAPORATORS • FILTERS • CRYSTALLIZERS
SPRAY DRYERS



PROBLEM: GUARANTEE TO
TO 0.15 GRAINS
SOLUTION: THE FLUOR GLYCOL-AMINE GAS-TREATING PROCESS
EXAMPLE: LYTLE GASOLINE ABSORPTION PLANT AT COALINGA, CAL.

The Lytle Gasoline Absorption Plant at Coalinga, California, is a story of the Fluor Glycol-Amine Gas-Treating Process at work.

Expansion of natural gas supply through deeper drilling introduced into the Lytle Plant a natural gas so high in hydrogen sulphide content that it was no longer acceptable as commercial sales gas. After processing for gasoline recovery, the discharge gas was analyzed and found to contain 1.25 grains of hydrogen sulphide per 100 SCF and up to three-fourths of 1 mol per cent of carbon dioxide. Even though this gas was sufficiently pure for sale in many areas, in this particular instance requirements for commercial gas were set to *not more than 0.15 grains of hydrogen sulphide per 100 SCF...* a purity requirement so stringent that it would only be attempted by Fluor Gas Processing Engineers using the Fluor Glycol-Amine Gas-Treating Process.

Following study of the requirement by Fluor, a Research Department pilot plant was set to run at gas composition and operating conditions simulating those at the Lytle Plant. Here it was *proved* the Fluor Glycol-Amine Gas-Treating Process could meet—*and exceed by a comfortable operating margin*—the 0.15 grain per 100 SCF requirement efficiently, economically, and on a guaranteed basis.

The plant for the Lytle job was then designed on the findings of the Fluor Research Department. Engineering was set in motion, and a field construction schedule formulated.

The Lytle unit is a "sweet"-running unit paralleling laboratory and pilot plant findings—meeting its guaranteed performance with an adequate margin. This new installation raises the total installed capacity of Fluor Glycol-Amine Gas-Treating Plants to 585,000,000 SCF/D.

Fluor invites owners and operators of gas-producing properties to submit their gas-treating problems for study and recommendation by Fluor's Gas Processing and Research Engineers. Let them study *your* particular problem—the range of purity obtained through use of the Fluor Glycol-Amine Gas-Treating Process is virtually unlimited. It may be the low-cost answer to your gas-treating problem.

OIL STEEL CHEMICAL member

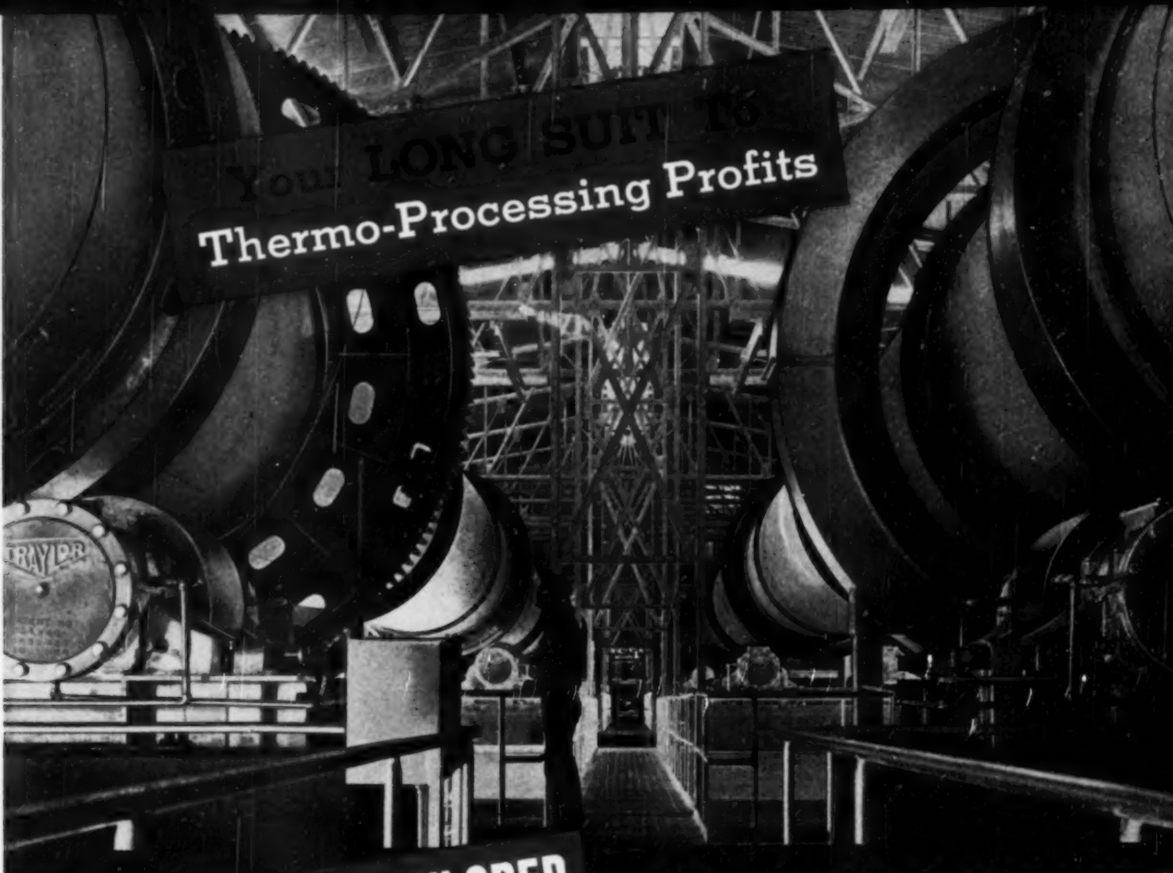
FLUOR

BE SURE WITH FLUOR

Designers and Constructors of Refinery, Chemical and Natural Gas Processing Units.

Manufacturers of Cooling Towers, Fin • Fan Units, Mufflers, Gas Cleaners, and Pulsation Dampeners.

THE FLUOR CORPORATION, LTD., *Los Angeles 22*—NEW YORK
CHICAGO • BOSTON • PITTSBURGH • TULSA • HOUSTON • SAN FRANCISCO



Rotary Kilns TRAYLORED to Your Specific Requirements

Every Traylor kiln has been constructed for a specific operation. During Traylor's more than 40 years of experience, this policy has ensured the greatest possible thermo-processing profits for many of the World's leading cement, lime, and chemical process plants. Only after every factor has been analyzed—raw materials, product characteristics, desired capacity, peak load anticipated, fuel available, space for installation, to mention some—is a kiln TRAYLORed for the job . . . constructed for peak profit capacity.

TRAYLOR KILNS REQUIRE LESS POWER ... LESS MAINTENANCE

The unusual strength and rigidity of Traylor all-welded steel kiln shells make Traylor kilns easier to align and keep in alignment. Traylor kilns require less power for turning . . . have lower maintenance costs. All controls are centralized to put every phase of kiln operation under the eye and control of the operator.

Write today for detailed information on Traylor's many structural advantages. Ask for Bulletin 115.

TRAYLOR SLURRY FEEDERS

For Accurate Feed Control

A Traylor Ferris Wheel Type Slurry Feeder is comprised of a steel disk-wheel rimmed with buckets, a constant level tank and a proportioner which diverts the flow of wet material at any desired rate. No equipment offers more accurate feed control to your kiln, mill or dryer. Sizes: 3' to 6'.

TRAYLOR ENGINEERING & MANUFACTURING CO.
191 Mill St., Allentown, Penna.
Canadian Mfr: Canadian Vickers, Ltd., Montreal, P.Q.
Sales Offices: New York, N. Y., Chicago, Ill., Los Angeles, Calif.

Traylor ROTARY KILNS
COOLERS · DRYERS · FEEDERS · GYRATORY CRUSHERS · JAW CRUSHERS · REDUCTION CRUSHERS · GRINDING MILLS

A "Traylor" Leads to Greater Profits

In most businesses, operating costs are still on the rise. But there's *one* man who *can* do something about it—he's the man whose job is to get maximum heat and power from fuel dollars. He knows you *get* maximum efficiency from Eagle-Picher Industrial Insulations because they're made of durable, chemically and physically stable *mineral wool,* noted for its low conductivity. They give long years of service and are easy to maintain and replace.

There's an Eagle-Picher insulation that can help reduce *your* operating expenses!

Let these Eagle-Picher products also save you money . . . power . . . time

Insulating Felts
Supertemp Block • Blankets
Loose Wool • Pipe Covering
Stalastic • Insulseal • Insulstic
Swetchek • Finishing Cements
Insulating Cements

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE PICHER

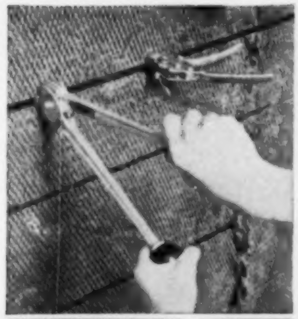
Since 1843

The perfect answer

FOR MAXIMUM FUEL SAVINGS AND EXACT TEMPERATURE CONTROL

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Mineral Wool Blankets, Supertemp Blocks, Super "66" Cement and Insulseal. They work effectively to give your equipment higher efficiency . . . cut operating costs . . . and help to provide perfect, precise control over temperatures.

Visit Booths 678 and 679 at the Chemical Show in New York November 28 to December 3



EAGLE-PICHER MINERAL WOOL BLANKETS

These blankets satisfy the need for a convenient method of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured between flexible metal fabric. Outstanding physical and chemical stability enable Eagle-Picher Blankets to resist water, steam, corrosive fumes and normal vibration.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700 F. Conductivity at 512 F. approximately 0.43...all standard sizes, from 3" x 18" to 12" x 36" ...in thicknesses from 1" to 4".

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft. —1 inch thick! Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800 F. Reclaimable when used on equipment whose temperatures go up to 1200 F.!

EAGLE-PICHER INSULSEAL

A tough, weatherproof, protective coating for insulation. For temperatures up to 450 F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY *General Offices: Cincinnati (1), Ohio*

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843

CUSTOMERS ALL OVER THE WORLD are sure of getting MARITIME—every time

—in drums protected by TRI-SURE CLOSURES

IN Bombay as well as Brussels—in Rio as well as Rotterdam—customers know they can count on Maritime's years of experience to produce high-grade lubricating oil. And they know, too, that Maritime will *deliver* that oil—no matter how many miles it travels—in exactly the same quality and quantity that leaves the plant in Houston. For every gallon of Maritime—Texas Special, Red Eagle, Blue Pennant and Marco—is packaged in drums equipped with Tri-Sure Closures.*

The Maritime Oil Company is using a *sure* means of maintaining customer confidence all over the world—because they are using drum closures that function with unfailing efficiency to prevent leakage, seepage, pilferage and substitution. Tri-Sure Closures have a *flange* that is an integral part of the drumhead . . . a *plug* that screws securely in place . . . and a leakage-proof, heavy-gauge *seal* which cannot be removed unless it is deliberately destroyed.

Again and again, the experience of leading shippers has demonstrated that *it always pays* to give fine oils and chemicals the protection of Tri-Sure Closures. It will pay *you*—in pleased customers, in product security, and in protection to your reputation—to specify "Tri-Sure Closures" on every drum order.

Tri-Sure CLOSURES

*The "Tri-Sure" Trademark is a mark of reliability backed by 27 years serving industry. It tells your customers that genuine Tri-Sure flanges (inserted with genuine Tri-Sure dies), plugs and seals have been used.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

SAVE ON POWER BILLS

WITH GENERAL ELECTRIC SYNCHRONOUS MOTORS

SYNCHRONOUS MOTORS IMPROVE POWER FACTOR

1. **Save you penalty charges for poor power factor**

2. **Release needed generating capacity**

Here's an example:

One mill improved power factor from 72 per cent to 84 per cent by installing a 300 hp .8 leading power factor G-E synchronous motor in place of another motor. This corrected power factor released 260 kva capacity in their generating equipment and allowed installation of additional motors.

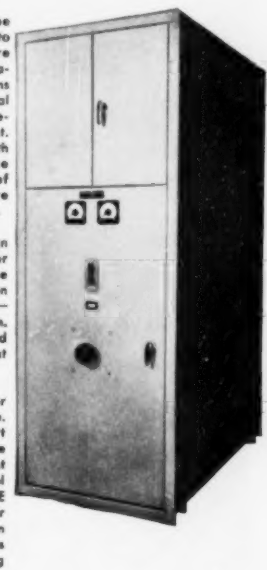
These savings in cost of operation are available to you.

Savings in the initial cost of equipment are also available—when synchronous motors are used in their natural fields of application. To find out about these natural fields of application, get in touch with our nearest office.

REMEMBER—General Electric Synchronous motors—whenever you need constant speed. They can give you lower initial cost, lower operating cost. For bulletin information, fill in the coupon:

G-E SYNCHRONOUS MOTOR CONTROL

MAKES SURE



G-E synchronous control provides the accurate adjustments that enable you to improve power factor. Here's where details count—where the slightest variation of a pointer on a meter means money saved—or lost. And General Electric has not overlooked these elements. Consider the meters for a moment. Here, G-E has devised a long scale with the pointer in the same plane as the figures so there can be no possibility of misreading the instrument. Anti-glare glass is used so no distortion is possible.

The new smaller rheostat, too, has design features that not only result in longer life but in greater operating convenience and accuracy. The handle has been molded to fit the fingers of the operator—to prevent slippage and over correction. You can be sure, too, that the new field circuit will respond instantly to rheostat adjustment.

Protection is assured the operator through the attractive steel enclosure. The cabinet resists blows, keeps out dirt and other operating hazards. All live parts are strongly guarded. Plant appearance is improved with this control designed to line up with other G-E power units such as switchgear. Ask your nearest G-E office for more information about this equipment that safeguards your investment . . . helps save operating expenses.

Apparatus Dept., Sec. E770-6, General Electric Company
1 River Road, Schenectady, New York

Gentlemen:
Please send me: ☐ GEC-505, Synchronous Motor Control
☐ GEA-529D, Low-speed Synchronous Motors ☐ GEA-5113, High-speed Synchronous Motors

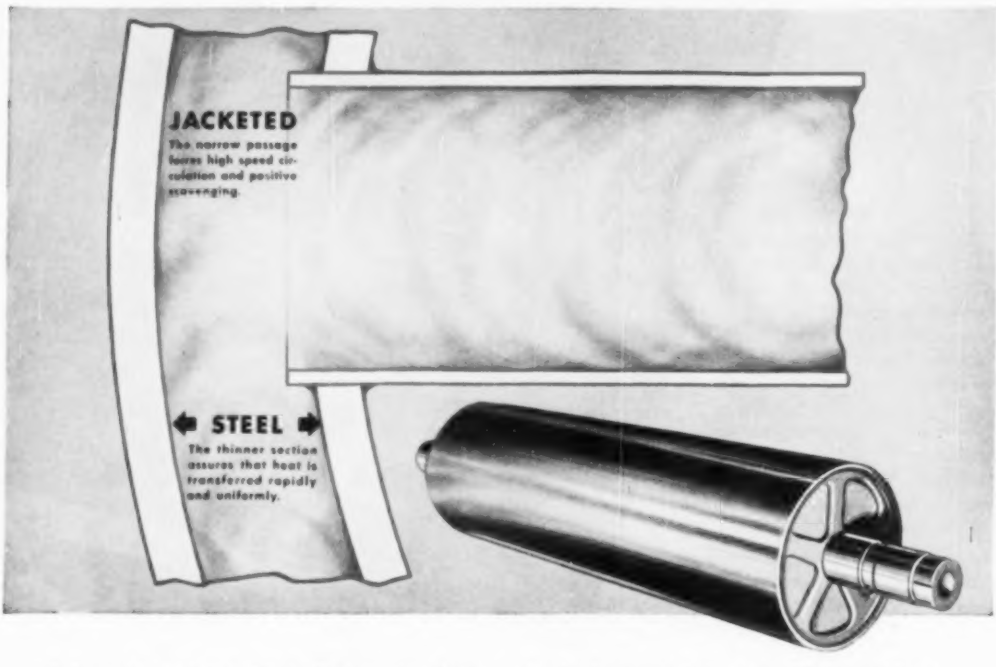
Name .... Company ....
Street .... City ....
State ....

GENERAL ELECTRIC


WATER COOLING TOWER
C.H. Wheeler
FAR OUTLASTS ITS DEPRECIATION PERIOD
Any water cooling tower "should" do all right for a few years, but after 5 or 10 years' service, users really appreciate the heavier, high quality materials and "tailor-made" construction of C. H. Wheeler. They still look and work "good-as-new" and continue to remain so for years and years, even where the installation location presents great weather extremes in summer and winter. Further, they are guaranteed to withstand hurricane winds up to 100 miles per hour. A good typical example of "5 year appreciation," and a repeat order, is shown in the photograph below, the latest installation, of course, being the new C. H. Wheeler "Funnel Top" Tower, which streamlines the flow of air from the water cooling zone to the Induced Draft Fans at the top of the tower. In 1955 or '60, you'll be glad, if you specify C. H. Wheeler Cooling Towers today. Write for Catalog No. 145.
C. H. WHEELER MANUFACTURING CO.
1808 Sedgley Avenue, Philadelphia 32, Pennsylvania
REPRESENTATIVES IN MOST PRINCIPAL CITIES
INSTALLED 1948
INSTALLED 1943
C.H. Wheeler
STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

YOU GET MORE HEATING DRYING CHILLING CRYSTALLIZING HARDENING OUTPUT

from steam (or coolant) *this way*



Lukenweld Jacketed Steel Rolls move heat rapidly—in or out. Their welded steel plate construction permits thin sections. Whether the task is heating or chilling, surface temperatures are more uniform and constant.

High steam pressures are employed with safety with Lukenweld Rolls. Records covering dozens of installations in a variety of industries show production increases of more than 60% over old style rolls. Bulletin 358 tells you more about them.

If you're interested in learning what Lukenweld Jacketed Steel Rolls will do for you, if you're needing an addition to present equipment or a complete new machine, get in touch with us. Lukenweld, Division of Lukens Steel Company, 400 Lukens Building, Coatesville, Pennsylvania.

Come see us at the Metal Show in Cleveland, October 17-21, Booth 503, and the Chemical Show in New York, November 28-December 3, Booths 558-563.

LUKENS

LUKENWELD DIVISION

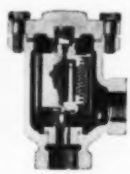
DESIGNERS, ENGINEERS AND MANUFACTURERS OF MACHINERY

How to be Right the first time

WHEN SELECTING STEAM TRAPS

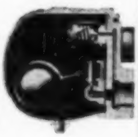
No single type of trap is suitable for all applications. But one of the four distinct Sarco types will be exactly right for any given application. Some provide quicker warm ups in the morning, some extract more of the heat, some are better for fluctuating condensate loads and others are better for out of doors. Sarco has the only plant devoted exclusively to complete lines of steam traps and temperature controls. To be sure, the first time, see Sarco first.

A — THERMOSTATIC



Wide open when cold for quick starts. Retains more of the heat before releasing condensate. Large valve orifice purges air quickly when starting. No seat changes when pressures change. Cannot freeze. Two types—for low pressure heating and high pressure industrial service up to 300 psi. Bulletin No. 250.

B — FLOAT



Ball float allows continuous discharge without shock to temperature controls and other instruments. Automatic thermostatic by-pass takes care of air and gases without steam waste. All pressures up to 200 psi. Bulletin No. 450.

C — BUCKET

Intermittent, but very rapid—can handle large volumes of condensate. Air goes out with the condensate. All parts attached to cover provide easy inspection. Straight-through connection makes installation easy. Integral strainer inside. Standard sizes to 250 psi. Forged steel types to 900 psi, and superheat. Bulletin No. 350.

D — LIQUID EXPANSION

A low cost combination of trapping and approximate temperature control. Ideal for outdoor tanks and lines and other points where condensate cannot be returned. In other forms, used as combination trap and control for wash tanks, food equipment, etc. Catalog Nos. 250 and 550.

APPLICATION	1st CHOICE	2nd CHOICE
Process Tanks, small	A	C
Process Tanks, large	B	C
Dryers, Coil Type	B	A
Dryers, Fan Type	B	C
Drying Tumblers	B	A
Water Heaters	B	C
Preheaters, Fuel Oil	B	C
Rotating Cylinders	B	B
Slashers	B	B
Dry Cans	B	B
Flat Work Ironers	C	B
Presses, Laundry	C	A
Stocking Forms	C	A
Presses, Plastics	C	A
Presses, Platen	C	A
Evaporators	B	C
Steam Lines Outdoors, small	A	D

Ask for Bulletin No. 1600 "Selecting Steam Traps"

267

SARCO SAVES STEAM

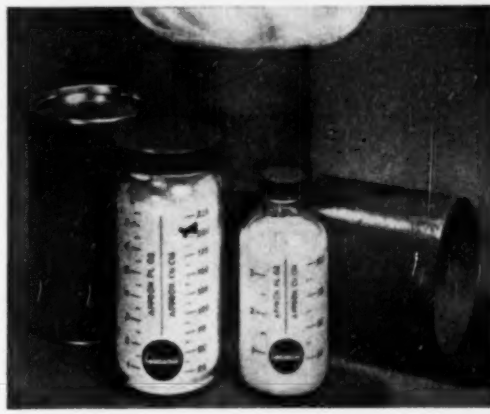
SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

Chemical Newsfront



PEPTON® 22, RUBBER PLASTICIZER reduces breakdown time by more than 50% and has the added advantage that it may be added directly to the latex solution prior to coagulation. This makes it possible to eliminate this operation in the compounding room—another important advantage. Photo above shows treated No. 1 Ribbed Smoked Sheets being examined as shipment arrived at a U. S. port. Further information on PEPTON 22 will be supplied on request. Just check the coupon below.

SAMPLE PACKAGES DRESS UP. Cyanamid's new sample bottles are graduated, in both fluid ounce and cc. scales, permanently fused in the glass, to enable users to approximate at a glance the amount of the contents. They also provide handy laboratory re-use containers. Two styles, narrow mouth for liquids and wide mouth for solids, are available in 4- and 8-oz. sizes equipped with screw caps made of Cyanamid's BEETLE® Plastic. This is another Cyanamid development in chemical packaging for convenience of its customers.

NATIONAL METAL EXPOSITION will be held in the Cleveland Public Auditorium, Cleveland, Ohio, October 21st to 27th. Cyanamid, exhibiting at the show, will have on display its AEROCARB® Carburizing Compounds and other products for the metal treating industries. Featured will be AEROCARB E & W, offering an improved "easy-washing" method that cuts washing time from hours to minutes, plus several other advantages. Advance technical information will be mailed on request.

American Cyanamid Company
Industrial Chemicals Division
30 Rockefeller Plaza, New York 20, N. Y.

Please send the technical literature on the products checked:

☐ UNITANE Titanium Dioxides for

....
(type of use)

☐ MELMAC Molding Compound
☐ Calco ULTRAMARINE
☐ PEPTON 22 Plasticizer
☐ AEROCARB Carburizing Compounds

Name..
Company..
Address..

C. E. 10-49

AMERICAN *Cyanamid* COMPANY

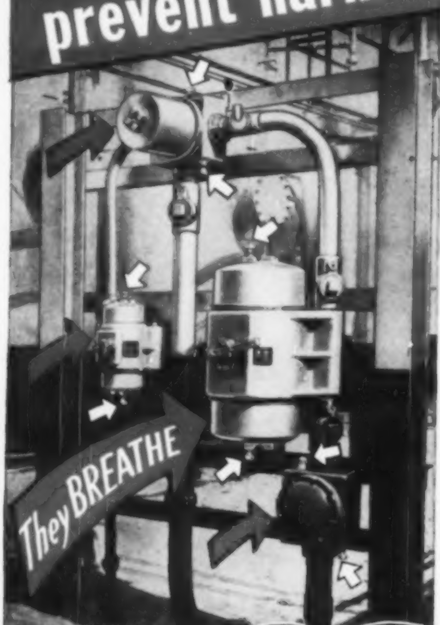
30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

CROUSE-HINDS
Breathers

prevent harmful water condensation

in explosion-proof
electrical conduit systems

under humid conditions



- **FORESTALL** the formation of destructive mildew by ventilating enclosures.
- **EXTEND the LIFE** of insulation and equipment under adverse conditions.
- **MINIMIZE** the danger of expensive shut-downs due to insulation or equipment failure.

Paragraph 5015-C5 of the 1947 National Electrical Code states that *"where there is a possibility that water or other condensed vapor may be trapped at any point in the raceway system, approved means shall be provided to prevent accumulation, or to permit periodic draining of such water or condensed vapor"*

Explosion-proof electrical enclosures cannot be vented in any of the usual ways because they must be kept flame-tight. Crouse-Hinds' explosion-proof Type ECD Breathers, Type ECD Drains, and Type EZD Drain Sealing Condulets meet the Code requirements and are listed by Underwriters Laboratories for such service.

The Breathers are similar to the Drains but have metal hoods which make them water and dust shedding. Both have corrosion-resisting bodies with internal flame-tight (but not airtight or watertight) labyrinths. They can be used freely without impairing the explosion-proof integrity of a conduit system, providing they are always installed in a Condulet hub or other opening *with five or more full threads engaged.*

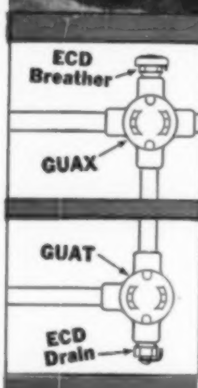
In humid atmospheres, water condensation occurs in explosion-proof systems, especially where temperature changes are frequent. Accumulation of water in harmful quantities is common. Mildew, a bacterial growth, is often present. It attacks many insulations and will destroy them unless the cause is removed. In such humid atmospheres troubles of this nature can be avoided by the proper installation of Crouse-Hinds' Breathers and Drains in conjunction with explosion-proof Condulets*.

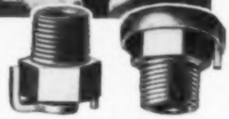
Breathers should be placed at the highest points and Drains at the lowest points of all housings and conduit runs. Heat generated by the current flowing through conductors and electrical devices raises the temperature of air within the conduit and housings. Breathers and Drains permit the resultant upward passage of the warmed air to remove moisture and thoroughly ventilate the enclosures. This prevents the accumulation of water and removes moisture that may have collected under unusual conditions.

This method is successfully used in many of the largest plants in the chemical and petroleum industries. Several years of field experience has demonstrated that the moisture is either entirely removed by ventilation, or so reduced that it is not harmful.

These devices have also been successfully used in non-hazardous locations where condensation is troublesome.

If you have a condensation problem, Crouse-Hinds Company will gladly assist in solving it. Write to





Type ECD Drain   Type ECD Breather

CONDULETS with Crouse-Hinds Breathers and Drains can be installed for ventilation throughout an entire explosion-proof conduit system

Type EZD Explosion-Proof Drain Sealing Condulet

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
Syracuse 1, N.Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit
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Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Washington.
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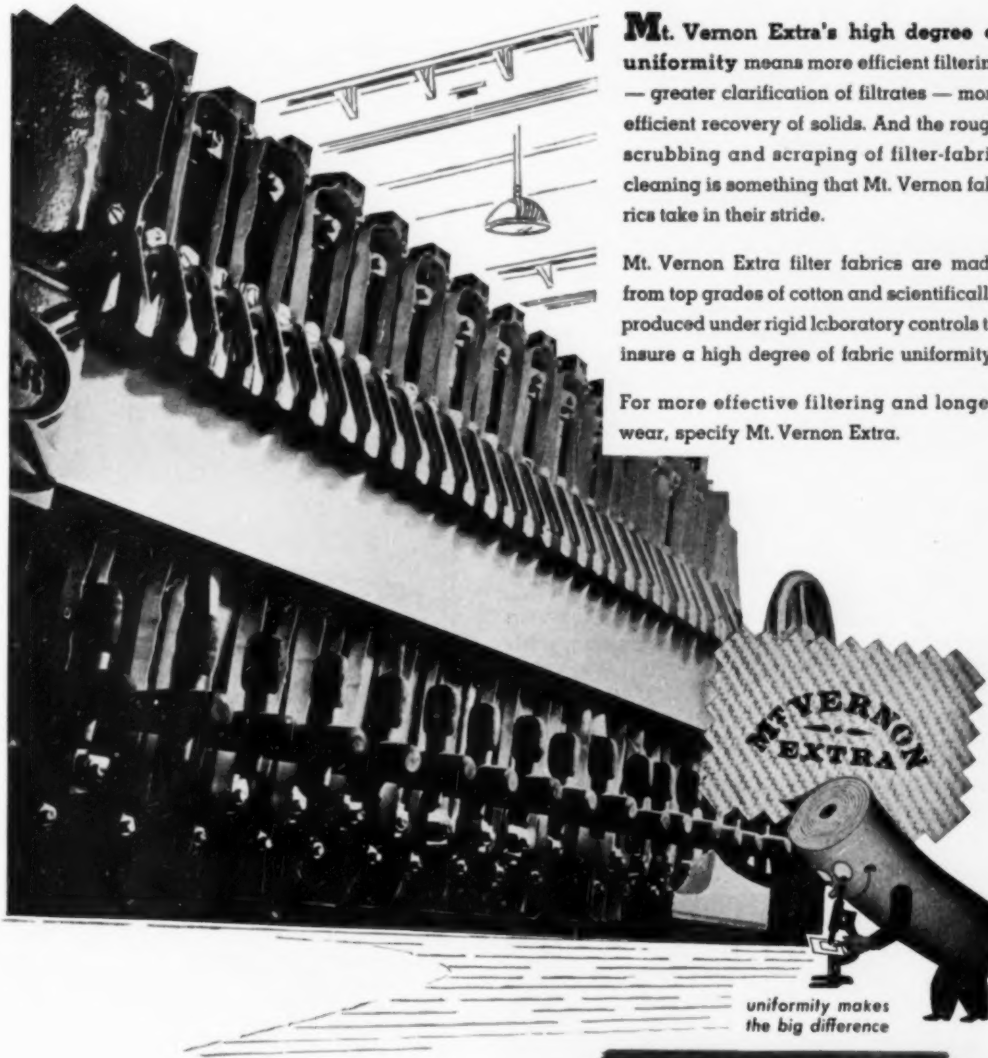
CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.

* *CONDULETS are made only by CROUSE-HINDS*

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

For More Efficient Filtering ...Mt. Vernon Extra



Mt. Vernon Extra's high degree of uniformity means more efficient filtering — greater clarification of filtrates — more efficient recovery of solids. And the rough scrubbing and scraping of filter-fabric cleaning is something that Mt. Vernon fabrics take in their stride.

Mt. Vernon Extra filter fabrics are made from top grades of cotton and scientifically produced under rigid laboratory controls to insure a high degree of fabric uniformity.

For more effective filtering and longer wear, specify Mt. Vernon Extra.

Mt. Vernon-Woodberry Mills

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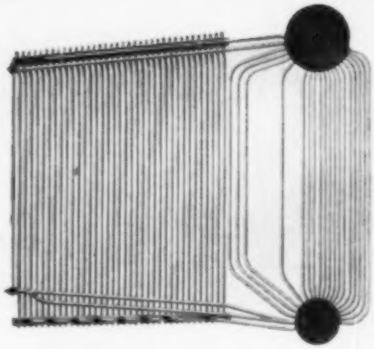
6 FEATURES

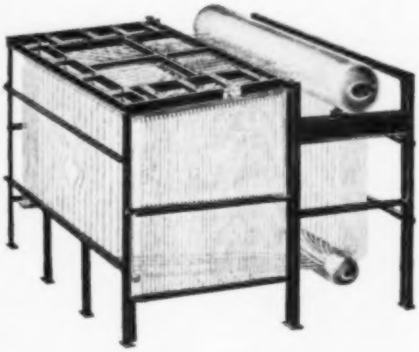
of the Vertical-Unit Boiler that assure low-cost steam for medium and smaller plants

The structural features illustrated and described on these pages are to a large degree responsible for the efficient combustion, consistent production of dry steam at all ratings, high thermal efficiency, trouble-free operation and low steam costs which characterize the operation of the many hundreds of Vertical-Unit Boilers, Type VU-50, in service throughout the United States and in many foreign countries.

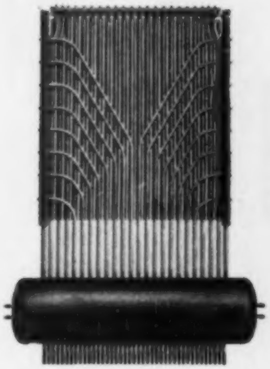
Designed to meet exacting, big-plant specifications, the VU-50 Boiler brings to medium-sized and smaller plants the advantages of Combustion's experience with high capacity, high pressure units, plus the obvious benefits of standardization. The VU-50 is virtually universal in application. It is available in capacities up to 350,000 lb of steam per hr. It can be adapted to meet widely varying conditions of load, pressure and temperature. It can be fired with coal, oil, gas or any combination of these fuels. Compare its features item by item with those of any similar equipment on the market. They explain why C-E Vertical-Unit Boilers are so widely regarded as the finest equipment available for any steam requirements to which they are applicable. B-321A



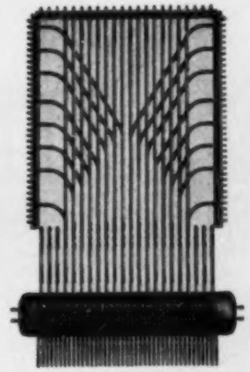
Symmetrical Design. Any section taken through the unit from the front to rear is similar to any other section so taken. Each elemental section includes the same amount of furnace volume, the same amount of boiler heating surface and the same amount of superheater surface as any other. The volume of gases, their velocity and temperature, at any point from front to rear, are practically constant across the width of the unit.



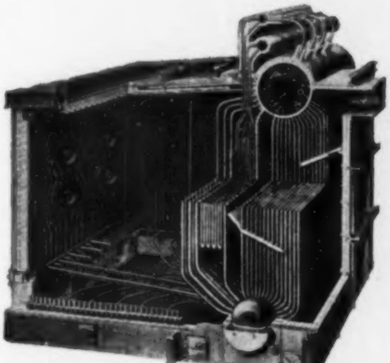
Overhead Suspension. Complete freedom of expansion in all directions is provided by suspension of all parts of the unit from the steel structure which provides the framework for the outer steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.



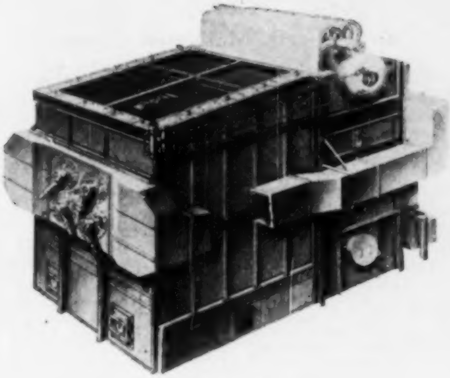
Quality Steam. All of the most active steam producing tubes enter a baffled area in the drum which discharges well above the normal water line and uniformly across the full length of the drum. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.



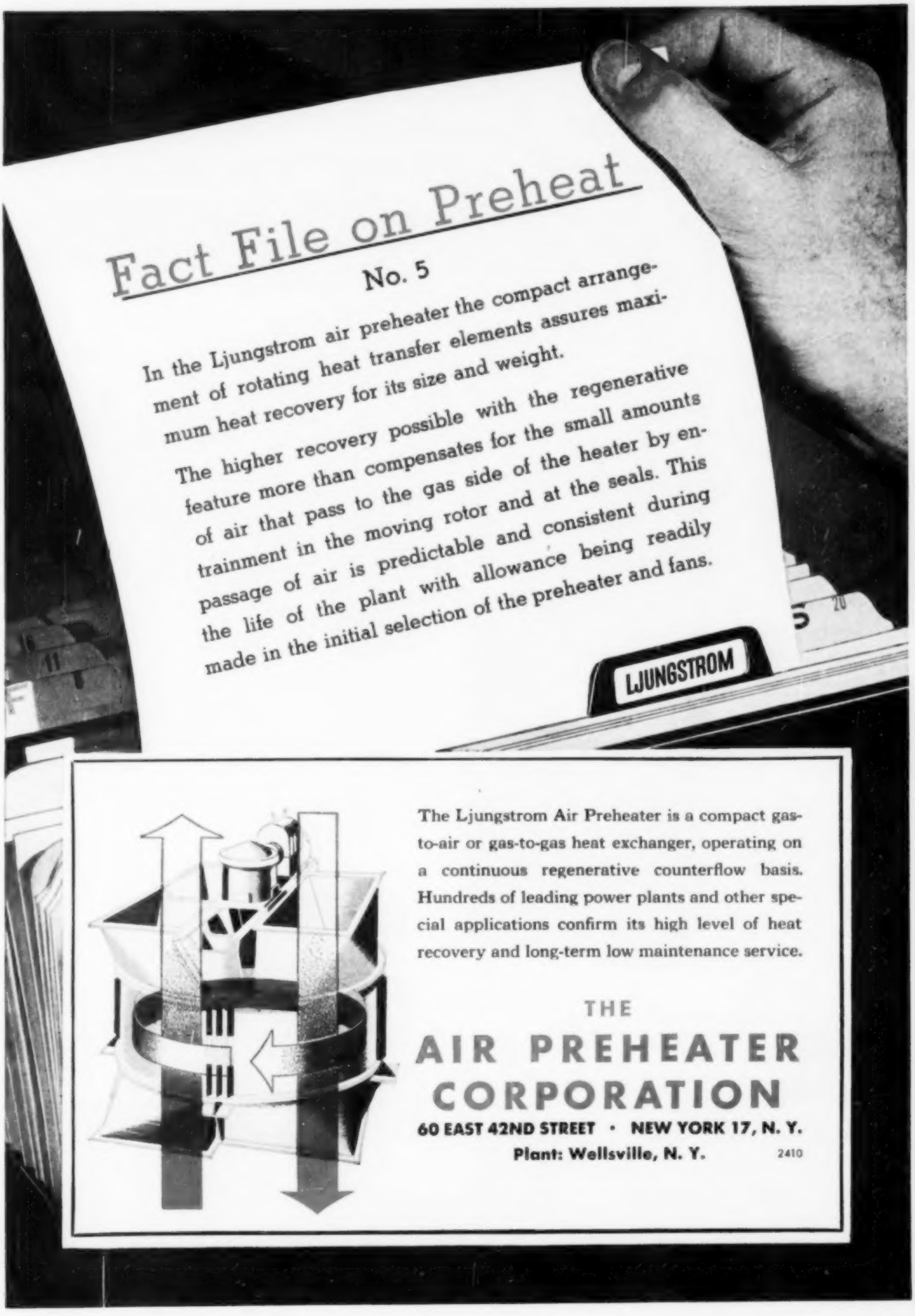
Standardized Construction. Painstaking refinement of detail is incorporated in each unit at a small fraction of the original engineering cost. With standard parts and structural features the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economies of standardization and the buyer benefits even before the VU Unit is placed in operation.



Adaptable In Application. The VU Unit can be adapted, without sacrifice of the benefits of standardization, to a great variety of conditions: where space limitations are imposed; to burn coal, oil, gas or any combination of these fuels; to meet widely varying requirements of load, pressure and temperature. Inclusion of inter-bank or inter-tube superheater or an air heater is easily accomplished as conditions require.



Steel Encased Setting. The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.



Fact File on Preheat
No. 5
In the Ljungstrom air preheater the compact arrangement of rotating heat transfer elements assures maximum heat recovery for its size and weight.
The higher recovery possible with the regenerative feature more than compensates for the small amounts of air that pass to the gas side of the heater by entrainment in the moving rotor and at the seals. This passage of air is predictable and consistent during the life of the plant with allowance being readily made in the initial selection of the preheater and fans.
LJUNGSTROM
The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.
THE
AIR PREHEATER
CORPORATION
60 EAST 42ND STREET · NEW YORK 17, N. Y.
Plant: Wellsville, N. Y.
2410

EXIDE-IRONCLAD BATTERIES
ARE DIFFERENT!

They are specially designed to provide years of dependable service in all MOTIVE POWER WORK

Storage batteries are called upon to perform many tasks. No single type of battery is adequately suited to all. To meet these numerous requirements, Exide engineers have developed special types, to fit each application.* Among these several types is the specially designed Exide-Ironclad Battery. Details shown below.

DIFFERENT IN DESIGN

DIFFERENT IN CONSTRUCTION

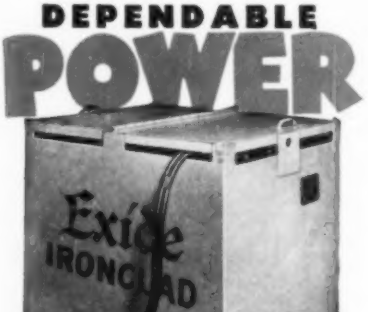
DIFFERENT IN SERVICE QUALITIES

Chief among these differences is the unique positive plate, an exclusive Exide feature.

EXIDE-IRONCLAD POSITIVE PLATE

Consists of a series of finely-slotted tubes which contain the active material. So small are these slots that, while permitting easy access of electrolyte, they retard the active material from readily washing out or jarring loose . . . adding considerably to life of plate.

Exide-Ironclad Batteries have ALL FOUR of the characteristics that a storage battery must have to assure maximum performance from battery electric industrial trucks — high power ability, high electrical efficiency, ruggedness and a long life with minimum maintenance. The combination of these four Exide-Ironclad characteristics assures years of dependable day-in, day-out service.



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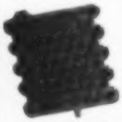
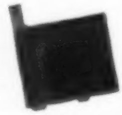


DESIGNED FOR STATIONARY USE

The Exide - Manchex Battery has the manchester type positive plate with the lead button construction. Specially designed for stationary use in many classes of industry.

DESIGNED FOR AUTOMOBILE USE



The Exide Automobile Battery has plates of staggered grid construction. Specially designed for use in automobiles, trucks, buses, aircraft and numerous other applications.

"Exide" and "Exide-Ironclad" Reg. Trade-marks U. S. Pat. Off.

1888 . . . DEPENDABLE BATTERIES FOR 61 YEARS . . . 1949

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • *Exide Batteries of Canada, Limited, Toronto*

AUTOMATIC

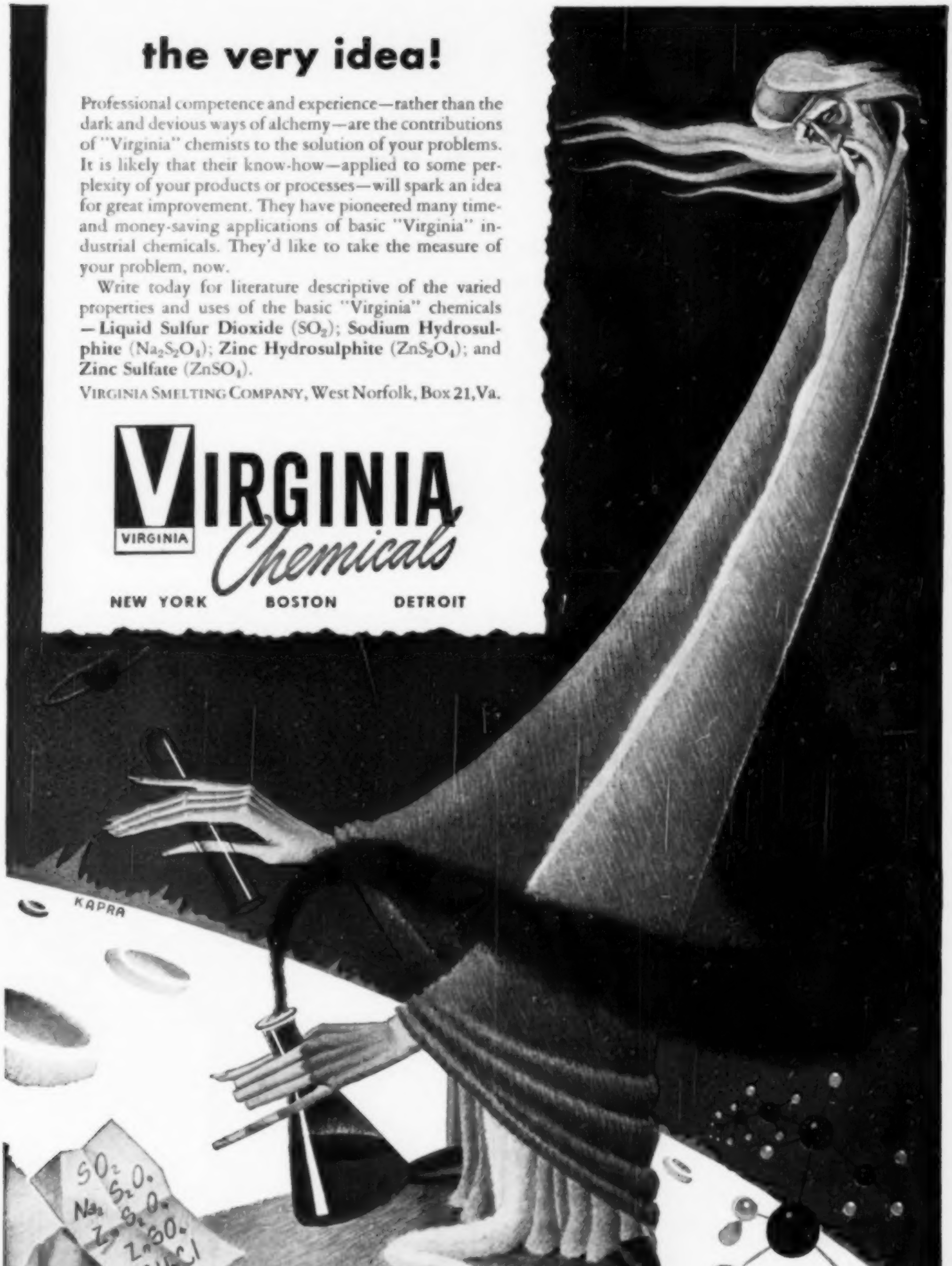
SELF-SEALING · SELF-ACTING · SELF-THINKING · CONTINUOUS PRESSURE · SPLIT-SECOND ACTION

Greatest improvement in history of Nordstrom valves

—gives effect of improved design without mechanical change

Tried, tested, proved in laboratory, field and plant

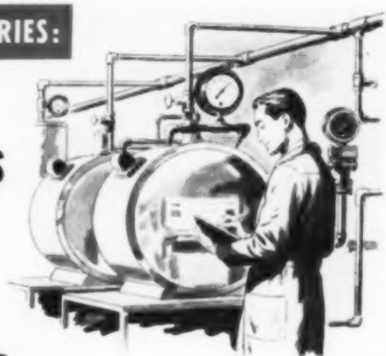
Keeps Nordstrom valves in state of perfect lubrication



KAPRA

IN THE CHEMICAL PROCESS INDUSTRIES:

6 out of 10 Men Who Buy Gauges Specify US Gauge



. . . Because USG Assures ACCURACY—DEPENDABILITY—QUALITY

There's no room for guesswork in selecting gauges to measure and control chemical, food and other processes. The preference shown for US Gauges by the majority of instrumentation men and chemical engineers is a reliable indication that US instruments give them more value . . . accuracy, dependability, quality.

They know that USG can supply gauges for all of their requirements however exacting . . . from highly specialized instruments measuring less than 1" of mercury absolute to standard type gauges measuring from 30" vacuum to 100,000 pounds pressure per square inch.

US Gauge's research and design engineers have pioneered the development of many new and improved gauges especially for application in the process industries. Get more information about these instruments now. Write today. Ask for a copy of the new USG catalog. No obligation.

United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Penna.

US GAUGES—BETTER INSIDE . . . BETTER OUTSIDE . . . BETTER ON YOUR PRODUCT

UNITED STATES GAUGE

ABSOLUTE PRESSURE GAUGE

A highly accurate, dependable instrument for measuring absolute pressures. Gauge is seal case type designed to indicate pressure or vacuum admitted to interior actuating the seasoned beryllium copper diaphragm. Black molded phenolic case is corrosion resistant, suitable for use in highly contaminated atmospheres. Dial is 2¾" in diameter. Ranges: 20 millimeters to 100 inches of mercury.

HIGH PRESSURE SOLID FRONT GAUGES

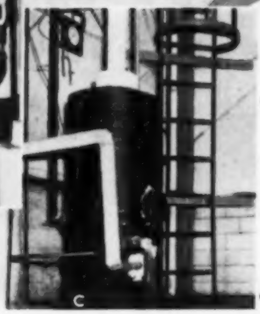
Designed for testing high pressure gases and liquids these gauges are built to the highest possible standard. Solid wall, cast integral with case, separates the tube and movement section from observer. Bourdon tubes of specially selected beryllium copper or stainless steel are threaded at both ends. Has deep bushed stainless steel movement of high ratio. Cast brass case and ring. Ranges 100 to 100,000 lbs. pressure.

SUPERGAUGE FIG. 1610

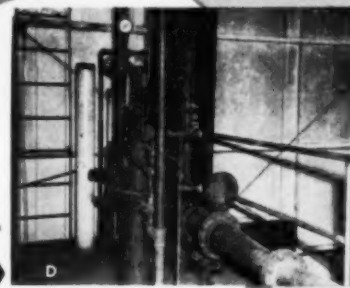
For heavy duty service where a gauge of exceptional quality and accuracy is required. Bourdon tube and heavy duty bushed movement of stainless steel to withstand corrosive atmosphere and pressure media. Available in cast iron or phenolic cases in ranges 0 to 30" vacuum to 20,000 P.S.I. Furnished in combination with a wide variety of precious metal diaphragm attachments.

PRODUCTS OF UNITED STATES GAUGE . . . Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges • Chemical Gauges • Dial Thermometers • Glass Tube Thermometers • Flow Meters • Inspectors' Test Gauges • Laboratory Standard Test Gauges • Marine, Ship and Air-Brake Gauges • Recorders • Controls and Alarm Gauges • Voltmeters • Ammeters • Welding Gauges

USG



C. Top of column

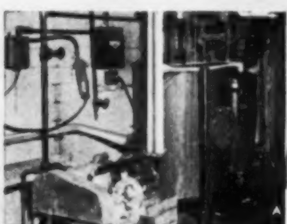


D. Steam jet vacuum equipment

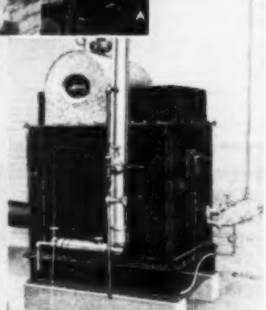
B. Heat exchanger

Continuous Deodorizers

for Edible Oils



A. Base of column and pumps



A Dowtherm boiler is used for heating.

Continuous deodorizer, as installed in Struthers Wells laboratory, the views above showing equipment at various floor elevations.

For the continuous deodorization of edible oils, Struthers Wells equipment is economical and efficient.

High vacuum, elevated temperatures and efficient equipment design gives low steam consumption. Liberal heat exchange equipment reduces the heating load, and the use of automatic controls largely eliminates operating attention.

The Struthers Wells Dowtherm heating system used is efficient and trouble free; steam may be directly superheated in furnace, thus reducing equipment costs.

A semi-plant scale continuous deodorizer as set up in our laboratory and shown in accompanying views, permits production of commercial quantities of oils under conditions closely approximating full scale operation.

On the basis of such tests, large scale equipment for the deodorization of special synthetic heat sensitive fats and other special oils has been constructed.

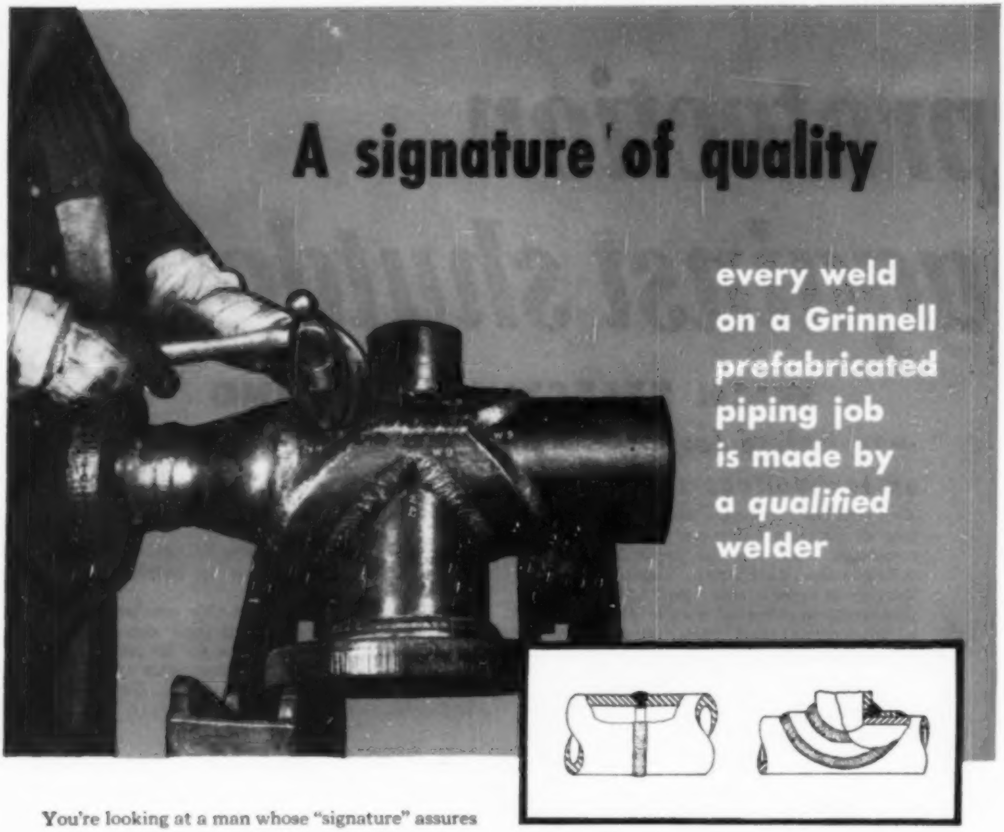
Struthers Wells also supplies complete batch deodorizers, or semi-continuous types.

STRUTHERS WELLS CORPORATION

***Process Equipment Dept.* WARREN, PA.**

Plants at Warren and Titusville, Pa.

Struthers Wells



You're looking at a man whose "signature" assures quality welding of piping. He's a Grinnell welder and, as every Grinnell welder, he is qualified by Grinnell according to a procedure which conforms to A.S.M.E. Boiler Construction Code, Section 9. After qualifying, he is given a number which he "signs" adjacent to each weld he makes.

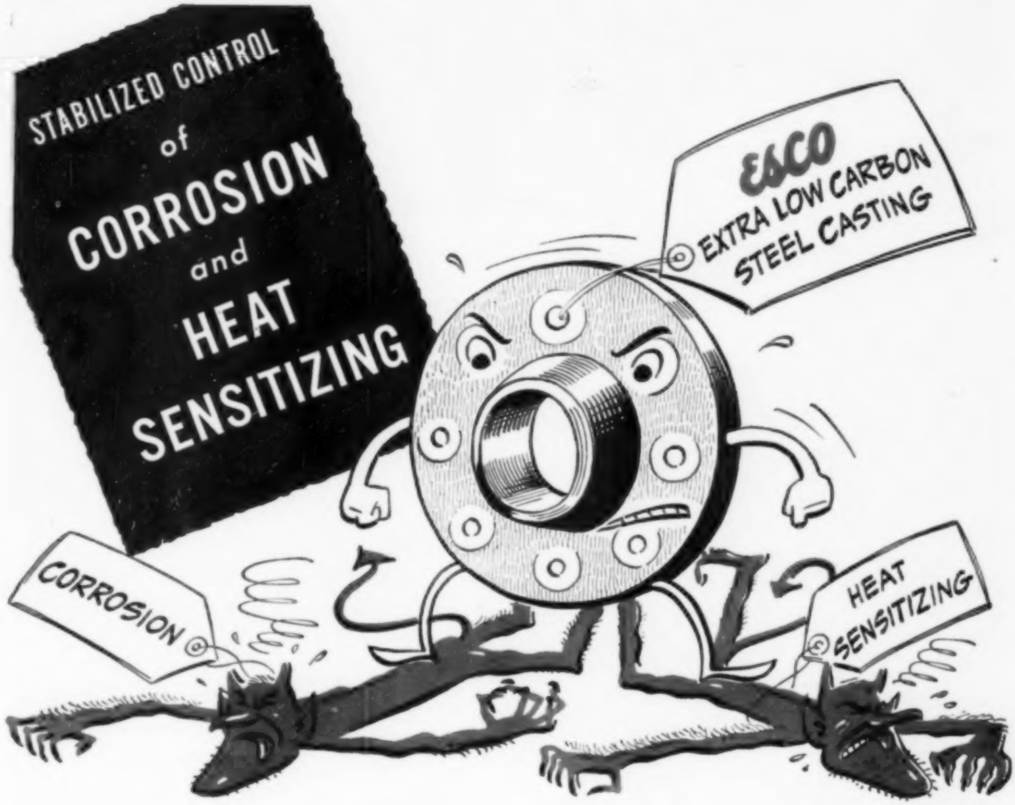
Quality welding is only one of a long chain of responsibilities assumed by Grinnell on every prefabricated piping job . . . from the interpretive engineering to the on-time delivery of the fabricated piping. Such responsibility requires facilities for metallurgical research and testing, comprehensive knowledge of state laws and industry codes, and a complete familiarity with insurance company requirements for fabricated piping.

The fabrication of piping for today's high pressure, high temperature or corrosive services is a job for experts. It's a job for Grinnell prefabricating plants because Grinnell has the modern equipment and methods, and the skilled personnel which enable them to assume total responsibility for the job.

99 YEARS
PIPING

GRINNELL

Grinnell Company, Inc., Providence, Rhode Island. Branches: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane



You can weld your stainless castings without subsequent heat treatment, yet retain initial effectiveness against corrosion . . . Your castings will handle materials heated to elevated temperatures without becoming sensitized . . . IF your castings are made of *ESCO* Extra Low carbon stainless steel.

With a maximum carbon content of .03%, these castings suffer a minimum of carbide precipitation when welded or heated. Initial resistance to corrosion and heat remains constant.

Perhaps an *ESCO* extra low carbon stainless steel casting will solve a problem in your plant. You are invited, without obligation on your part, to write us about it. Completely staffed engineering and metallurgical departments are available to help find a practical solution.

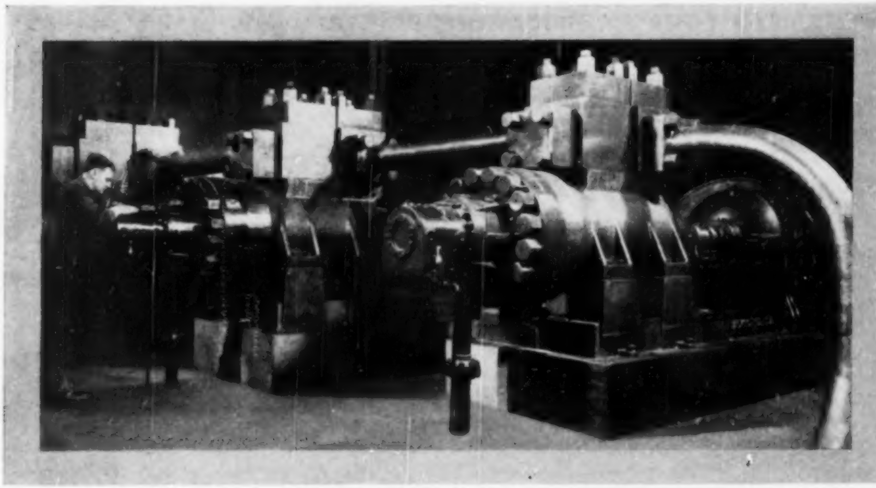
Literature available upon request.

Electric Steel Foundry, 2143 N.W. 25th Avenue, Portland 10, Oregon. Offices in Eugene, Oregon; Chicago; Honolulu; Houston; Los Angeles; New York City; San Francisco; Seattle and Spokane. In Canada, *ESCO* Limited, Vancouver, B.C.

ESCO

STAINLESS and HIGH ALLOY STEELS for the PROCESS INDUSTRIES


1 Seamless and Welded — B&W makes *both.*
2 Full range of austenitic and ferritic stainless steels available.
3 Sizes up to 8⅝" O. D. and a wide choice of finishes.
4 Special analyses, sizes, gauges, and lengths.
5 Nation-wide availability—through B&W officesand distributors all over the U.S.A.
5
Reasons why
B&W
STAINLESS
TUBING
answers your chemical processing requirements
MOST ECONOMICALLY
unbiased assistance in choosing the grade of stainless tubing that will give you the best possible service-to-cost ratio on each application, *plus* the convenience of a single source of supply for all stainless tubing needs.
B&W
SEAMLESS and WELDED
TUBES
THE BABCOCK & WILCOX TUBE COMPANY
GENERAL OFFICES: BEAVER FALLS, PA. PLANTS: BEAVER FALLS, PA. AND ALLIANCE, OHIO
TA-1457 S



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to insure top performance, long life

Largest pump capacity in terms of pressure and volume of any industrial centrifugal pump installation in the world is found in the hydraulic system of the 18,000-ton forging press at Wyman-Gordon Products Corporation. Capacity is 1500 gal. per min. at 5300 lbs. per sq. in. — enough energy to pump the water contained in twelve tank cars in one hour from sea level to the top of Mount Whitney (altitude 14,510 ft.)

This unusual installation consists of three 8-stage units connected in series. Pressure increase through each pump is 1750 lbs. per sq. in. Each is driven by a 1,000 hp motor, and has an individual lubricating system which supplies Gulf Harmony Oil, noted for its successful performance under heavy loads, to the pump and motor bearings. Gulf Harmony Oil is rust and foam inhibited and has outstanding resistance to oxidation—helps insure long trouble-free pump and motor life.

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Tygon Paint is inert to most alcohols, to fresh or salt water, to oil and grease . . . stands up under abuse that quickly kills ordinary coatings.

There are other things about Tygon Paint Coatings you'll like: no cracking, checking or crazing; a really *flexible* film that "gives" under impact without chipping or flaking; high electrical insulating properties; a film that is non-toxic, non-contaminating and non-flammable.

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in your own plant . . .

Your own maintenance crew can easily use Tygon Plastic Paint Coatings to protect walls, structural steel, tank exteriors, fume hoods and ducts, etc. Apply by spray gun or brush—air dries quickly. Use on wood, metal or concrete. Would you like a free test sample? *Write today*

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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

October 1949, Volume 56, Number 10

Competitor for nylon?

Monsanto and American Viscose have teamed up and organized a new company—Chemstrand, Inc. Its object: production of a new synthetic fiber that will compete with nylon.

Little has trickled out about the new fiber. Talk is that it is 85 percent acrylonitrile. What the other 15 percent may be is still a deep, dark secret.

Grapevine has it that Monsanto is arguing for a plant at Texas City, while American Viscose wants it in Virginia. A factor involved: the plant will need plenty of natural gas.

Since the new fiber has yet to be market-tested, odds are that Chemstrand's first move will be to put up a pilot plant.

Industrial Rayon is another company working hard on a nylon competitor. The company will not discuss its work, but a year and a half ago it hired Herman A. Bruson to head up synthetic fiber work. It was said then that Bruson had been given essentially unlimited facilities to do the job—but a time limit of four years. He is said to be working with acrylonitrile, too.

Other companies working with acrylonitrile include Du Pont and Carbide. Du Pont, of course, is nearing commercial reality of its all-acrylonitrile fiber, Orlon. Carbide is supplying the trade with pilot plant quantities of its Vinyon-N (*Chem. Eng.*, Mar. '48, p. 120), a copolymer of vinyl chloride and acrylonitrile. Although meeting with increasing acceptance, little possibility of greatly increased production, on the scale of nylon, is foreseen.

Novel hydrogenation process

An installation just completed at the Los Angeles plant of W. C. Hardesty Co., Inc., producer of fatty acids, features a unique hydrogenation process. Two things are unusual about this process.

SELECTIVE—First of all, the process used is selective hydrogenation, utilizing fatty acids instead of the commonly used glycerides.

HYDROGEN FROM AMMONIA—Second feature of Hardesty's hydrogenation installation is its source of hydrogen. Anhydrous ammonia is dissociated to get the hydrogen. Drever Co. of Philadelphia designed and installed the dissociating and ammonia-handling equipment.

Patterson Foundry & Machine Co. cooperated with Hardesty on the laboratory and pilot-plant work that preceded the design of the equipment required to meet critical conditions in the handling of fatty acids. It took Patterson more than a year to fabricate the equipment.

The new hydrogenation process makes possible production to precise specifications, with greater purity, uniformity and heat stability. Poly-unsaturates can be eliminated or lowered to requirements through the new process.

Big titanium ingots coming

Already making 65-lb. titanium ingots, Allegheny Ludlum expects to produce 400-lb. ingots by the end of this year. With a large order for titanium forgings to be used in gas turbines on its books now, Allegheny is also ready to take orders for wrought titanium in any form.

Allegheny is asking a steep price, about $20 a lb. for strip. But within a few years the company hopes to cut the price drastically. Eventually, titanium will probably be competitive with stainless steel.

Pure titanium is as strong as stainless steel but weighs only 60 percent as much. It has greater resistance than stainless steel to corrosion by salt water and acids. Even more important, it has a much higher heat resistance. This makes it a strategic metal in the age of jet propulsion and nuclear fission. Titanium fills the wide gap between light aluminum and heavy steel.

Until now, Allegheny Ludlum had kept mum about its interest in titanium. Now it appears that Allegheny is out in front of the pack in the highly competitive new titanium field.

Trust-busters go after chemical companies

Anti-trust activity is stepping up. For one thing, the trust-busters have about 300 lawyers in their corps now—100 more than they had a couple of years ago. What is more, the Republican 80th Congress boosted the anti-trust appropriation by 40 percent to a new high of $3.4 million. And this Congress is keeping the kitty up there.

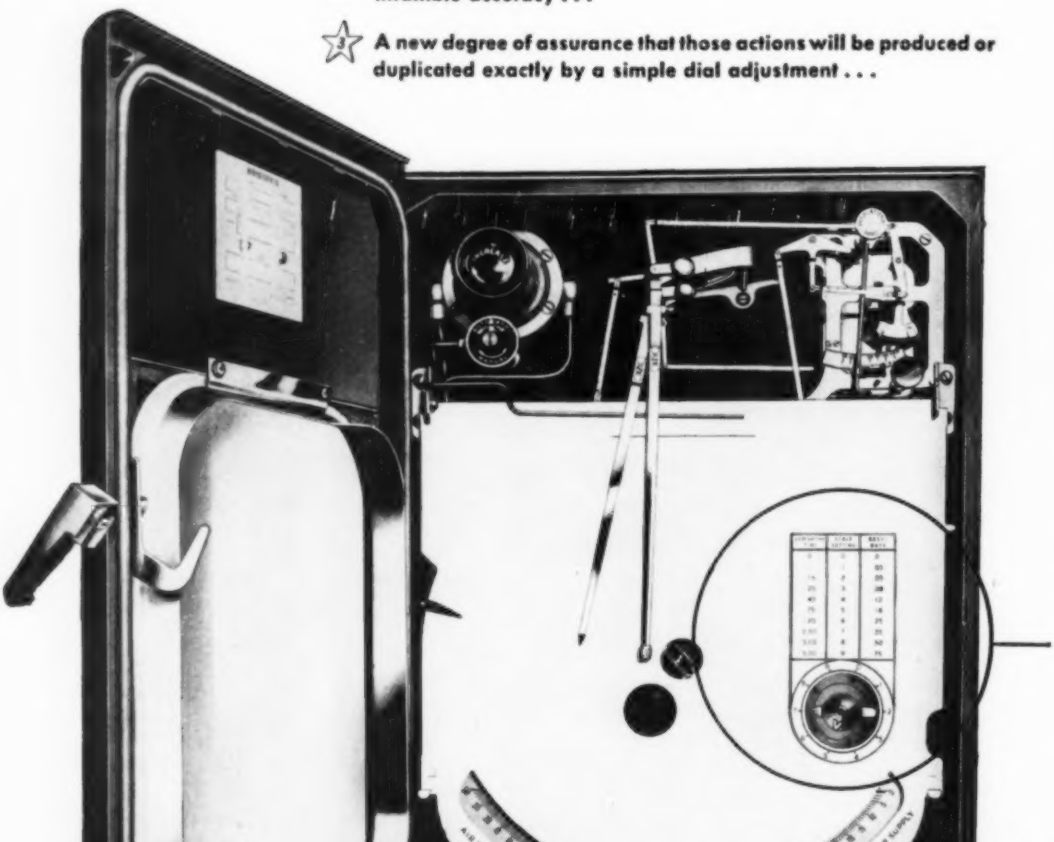
For another thing, anti-trust chief Herbert Berg-

(*Continued on page 70*)

LIFT YOUR PROCESSING TO A NEW HIGH IN ACCURACY

WITH BRISTOL'S NEW CONTROLLERS

1. **A new standard in automatic control . . .**
2. **A new opportunity to produce any desired control action with infallible accuracy . . .**
3. **A new degree of assurance that those actions will be produced or duplicated exactly by a simple dial adjustment . . .**



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These Features are NEW and EXCLUSIVE

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Adjustments are accurately calibrated and exactly reproducible. Similar settings in any Series 500 Controller will produce *exactly the same* values.

This means that you can standardize controller adjustments for any given process throughout a plant or throughout a national organization. It also means you can replace controllers on a process with full assurance that such replacements will exactly duplicate the performance of the original.

No more cut-and-try to arrive at the original setting... saves hours by reducing shutdown time.

2 SIMPLEST CONTROL SYSTEM TO SERVICE

Only one service adjustment is needed. The control units and parts making up the control system are so accurately designed and tolerances are so closely controlled that the system can be completely disassembled and reassembled, even with replacement parts, with only one simple adjustment needed to put the system in exact calibration.

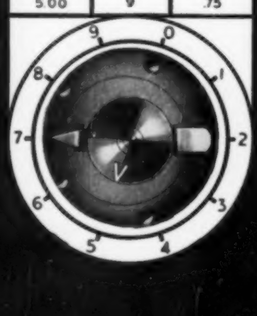
Almost anybody can service a Bristol Series 500 Controller.

3 ALL RESET CONTROLLERS HAVE RESET ACTION STOPS

Ask about this new advancement in automatic control.

CALIBRATED SCALE

DERIVATIVE TIME	SCALE SETTING	RESET RATE
0	0	0
.1	1	.03
.15	2	.05
.25	3	.08
.40	4	.12
.75	5	.18
1.20	6	.25
2.00	7	.35
3.00	8	.50
5.00	9	.75



Reset rate and derivative time adjustments are calibrated in equal percentage (or logarithmic) steps. Changes of one step up or down from any setting will produce a change which is a constant percentage of the previous setting—the most convenient way to calibrate an industrial adjustment.

With these calibrated adjustments, you can positively reproduce, at any time, any previously-established control action . . . by merely duplicating the settings on the scales—in the same or in any like Series 500 Controller.

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60 YEARS... 1889-1949

BRISTOL

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

son is turning his legal eagles loose on the biggest game he can find. Bergson takes pride in the cases he has filed since he got the job in June last year, such as the whopping Du Pont-General Motors-U.S. Rubber action.

Big court battles are slated for this fall and winter in federal courts throughout the country. Among those of interest to the chemical process industries are the actions against Imperial Chemical Industries, Ltd., and Du Pont, against the U.S. Alkali Export Association, and against Du Pont-General Motors-U.S. Rubber. These cases are not likely to be delayed, as they have been, by crowded court calendars. Reason: Congress has just authorized the appointment of 21 new district court judges and 6 new judges in courts of appeal. The new totals: 212 and 59 respectively.

Scheduled for trial in New York around the first of April is the government's cartel case against the British ICI, Du Pont and Remington Arms on charges of allocating territories and fixing both quotas and prices on firearms, ammunition and chemicals.

Recently the government won a decision in New York, when the first court interpretation of the immunity given to export trade associations by the Webb-Pomerene Act of 1918 was handed down.

The U.S. Alkali Export Association entered into agreements allocating world markets with foreign producers of sodium bicarbonate, soda ash and caustic soda. The exporters claimed that such agreements were immune, under the Webb-Pomerene Act, from the anti-trust laws.

But Judge D. J. Kaufman held that the Webb-Pomerene Act, while allowing U.S. exporters to get together to foster competition in world markets, does not permit them to get together with foreign producers to stifle competition.

Hearings this winter will determine what specific arrangements the alkali eporters may make.

In one of the biggest anti-trust cases ever filed, the government seeks to sever the ties that the Du Pont company and the Du Pont family have with GM and U.S. Rubber. It will be months before this case comes to trial.

Rubber patent pool ending

The government pool of patents and know-how on synthetic rubber has ended—unofficially but effectively.

Rubber companies are now free to take out patents on their own account and to develop their own techniques for the first time since December 1941. Research findings on synthetic rubber were ordered pooled at the start of the war to speed development.

Further, ending of the patent pool should soon bring onto the market new special synthetic rubbers —to team up with oil-resistant neoprene, butyl for inner tubes and the government's new cold rubber for tire treads.

Conclusion of agreements with the Canadians—also partners to the pool—is the only item holding up official announcement of the cancellation.

Terms already have gone out for signature to U.S. participants. Termination date is retroactive to March 31.

Foundation bill pigeonholed

Representative James W. Wadsworth, New York Republican, declares that the Rules Committee of the House will take no action on the National Science Foundation bill (H.R. 4648) during this session. This is despite the fact that it has been proposed to limit appropriations for the foundation to the sum required for organization and administration during its first year.

Wadsworth's proposal that the measure be pigeonholed has been accepted by J. Percy Priest, Tennessee Democrat, author of H.R. 4648. And, it is reported, the President has also accepted the proposal.

Under the circumstances, it is difficult for Representatives Wadsworth, Christian A. Herter, Massachusetts Republican, and Adolph J. Sabath, Illinois Democrat, to justify their opposition to the foundation on the grounds of economy. But no other reason has been given.

Chrome and chromate hazards

With its Donora smog report out of the way, look for the U.S. Public Health Service to come up soon with a report on hazards in the chromate industry. A study was requested by the industry last year, but it was put aside in favor of the all-out investigation of air pollution at American Steel & Wire's zinc works.

Import controls on tung oil

Secretary of Agriculture Charles F. Brannan has initiated steps to impose import controls on tung oil. This move to control dumping of foreign tung oil and other fats and oils on the U.S. market has the backing of Senators Claude Pepper, Florida Democrat, and John C. Stennis, Mississippi Democrat. The Tung Growers Council of America is also behind it.

Tung oil is included in the Anderson agricultural bill that provides 60 to 90 percent of parity for tung nuts. The bill is slated to come up for a vote in the Senate is soon as the reciprocal trade agreements measure is disposed of.

Meanwhile, the price of tung oil jumped recently to 25 c. a lb. in tank cars after a slump last summer to

(*Continued on page 72*)

3 important additions

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PARA-DICHLOROBENZENE
All standard mesh sizes
Packed in 25, 50, 100 and 200 lb. fiber drums

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8,000 gallon tank cars

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CALCIUM CHLORIDE
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MODIFIED SODAS
MURIATIC ACID
SODA BRIQUETTES *(Iron Desulphurizer)*
PHOSFLAKE *(Bottle Washer)*
HI-SIL *(Hydrated Silicate)*
SILENE EF *(Hydrated Calcium Silicate)*
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18 c. Stocks of tung oil are reported at a 10-yr. low of 12 million pounds, with consumption about 7 million pounds a month.

Very little oil is coming in from China. But Argentina, according to government reports, recently sold 6,600 tons of tung oil to the U.S. for October and November delivery.

Lamont Rowlands, chairman of the legislative committee of the TGCA, believes that import controls will go further toward solving the industry's problems on a permanent basis than most other avenues of relief the industry has tried.

Impact of devaluation on chemicals

How will devaluation affect world trade in chemicals? Chemicals coming into the U.S. for which the supply is greater than the demand will fall in price, though probably not by the same percentage as the currency was devalued.

The old dollar price or higher will prevail for U.S. imports for which the demand is equal to, or greater than, the supply. Pound sterling prices of tin, copper, lead, zinc and aluminum, for example, have been raised to the old dollar rate.

When it comes to U.S. sales of chemicals abroad, American producers are faced with the fact that their products, which they must sell for dollars, have been raised in price by the extent of devaluation in the country of sale. This means the foreign buyer will have to pay up to 30 percent more for the U.S. chemical products than he will for the same commodities bought in another soft-currency country.

Even though this is an added incentive to try to buy non-American, chances are the buyer has already exhausted most other sources. So he must take the U.S. products or close down his plant.

This means that, while devaluation may depress U.S. chemical exports somewhat, the over-all loss of foreign markets probably will not be very much. Besides, so long as the U.S. is even a marginal supplier, the high non-dollar prices will tend to act as support prices for the rest of the world, thus lessening delivered price differentials.

Canadian venture for General Aniline

Formation of a Canadian company known as Chemical Developments of Canada, Ltd., jointly owned by General Aniline and Standard Chemical Co., Ltd., of Canada, is revealed by General Aniline's President Jack Frye. The new company will utilize General Aniline's know-how and assigned patents to produce organic chemicals not heretofore made in Canada.

First products to be manufactured by Chemical Developments of Canada, Ltd., will be a group of synthetic non-ionic detergents made from ethylene oxide. Engineering and design of a new plant to produce these detergents is well advanced.

Authorized capital of Chemical Developments is $14 million. Stock ownership is divided between the originating companies, with Standard Chemical holding 51 percent and General Aniline 49 percent.

Refinery operators are supervisors

SUPERVISORS—Operators in the chemical division of a refinery have been declared "supervisors" by the National Labor Relations Board. They are therefor ineligible, under the Taft-Hartley Act, for membership in the bargaining unit with other employees. Part-time operators, who work one day a week as operators and as helpers the rest of the time, have also been declared to be supervisors.

The NLRB made this ruling when the CIO Oil Workers International Union sought to represent certain of the employees of Pan American Refining Corp.

DEGREE OF AUTHORITY—Crux of the matter is the degree of authority exercised by an operator. While on the night shift, the operator is in full charge of all operations. He checks functioning of equipment, and he has authority to call out maintenance men in the event of a breakdown or other emergency.

Moreover, the operator has the power to change the assignments of the nine men working under him, to discipline them for breach of rules, to grant time off when necessary and, effectively, to recommend raises or discharges. He spends from two-thirds to three-fourths of his time supervising other shift employees.

ELECTION ORDERED—NLRB ordered an election for all production and maintenance employees to determine whether or not these employees wish to be represented by the OWIU. Excluded are office and clerical employees, guards, operators and all other supervisors.

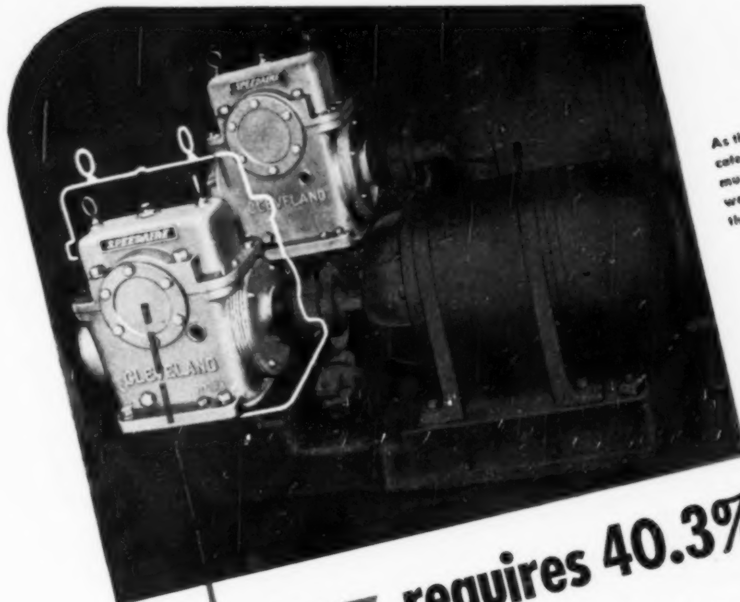
Strike at Jefferson's Port Neches plant

When the CIO Oil Workers International Union called a strike of production employees there on September 7, the Port Neches, Tex., plant of Jefferson Chemical was shut down.

The company and the union had been negotiating their initial contract for several weeks. A last minute attempt was made to settle their differences with the aid of a Federal Mediation Service conciliator. When this failed to bring a settlement, the OWIU, representing the production employees, called the strike.

Jefferson has offered the production employees a 15 c. an hr. increase. This would make their rates

(Continued on page 74)



higher than the average of chemical industry in the area. This offer was turned down. The union is holding out for 25 c. to 45 c. an hr.

Among other issues involved in the strike are the right of the company to determine the size of the plant working forces and whether the company shall be required to negotiate upon union demand for reduction of the work week from 40 to 36 hr., subject to threat of strike if not settled by negotiation.

Chemicals from seaweed

Florida Agar & Products, Inc., plans the construction of a $75,000 plant at East Point, across the bay from Apalachicola, Fla., according to Arthur L. Tucker, Jr., president and manager.

The newly formed corporation will extract agar from seaweed, together with other chemicals yielded from marine grasses.

Tennessee Eastman moves into Texas

PLANT SITE—Longview, Tex., has finally been picked as the site for the new plant of Tennessee Eastman. The multi-million dollar unit will be located near the Sabine River in Gregg and Harrison Counties.

LABOR SUPPLY—For a time, Victoria, Tex., had been seriously considered as a plant site. But, since Du Pont had skimmed the cream off the labor supply at Victoria for its plant there, Longview, with its large labor force, looked like a better bet.

CONSTRUCTION—Initially, about $4 million will be shelled out on a plant that is expected to be operating late in 1950. But this unit will occupy only a few of the 2,300 acres that Tennessee Eastman has acquired.

RAW MATERIALS—The city of Longview has agreed to sell water to Tennessee Eastman for 1c. per 1,000 gal.

Proximity to abundant oil and natural gas, sources of ethane and propane raw materials, influenced the decision to build at Longview.

PRODUCTS—Acetic anhydride will be made from ethane via acetylene. This and other chemicals made in Texas will be shipped to the company's Kingsport, Tenn., plant.

Construction of a rayon plant at Longview, to turn out cellulose acetate, is a long way off. So far, no arrangements have been made for bringing in cellulose pulp for rayon making.

More ammonium sulphate

Finney Chemical Corp. starts producing ammonium sulphate this month at its Houston, Tex., plant. Capacity: 6,000 tons a month.

This company, jointly owned by H. T. Finney and W. T. Allison, has been turning out solid caustic for Diamond and others.

Superphosphate plant for Stauffer

Construction of a new $400,000 superphosphate plant for Stauffer Chemical at Tacoma, Wash., is now under way. When the plant gets going early next year, it will turn out more than 30,000 tons of superphosphate a year.

Stauffer will get phosphate rock for its Tacoma plant from deposits it owns at Sage, Wyo. To get sulphuric acid, Stauffer has contracted for the entire output of the new 100-ton-a-day acid plant of American Smelting & Refining at Tacoma. The AS&R plant utilizes waste stack gases.

Phenol demand rising

Phenol, hard to get during the war, has been in better supply since December 1948. Now, however, Dow reports that demand has climbed sharply since mid-August.

Right now you can still get plenty of phenol with normal delivery schedules. But the squeeze is on. Some of the crystal-ball boys prognosticate that supplies may tighten up this fall. Accordingly, Dow is planning enough future production of USP phenol to satisfy its regular customers.

Smart oil men, these farmers

CAT CRACKER—The Indiana Farm Bureau Cooperative Association, Inc., is going to install a fluid catalytic cracking unit at its Mount Vernon, Ind., refinery. The unit, to take 4,000 bbl. of charge stock a day, is being designed and engineered by Universal Oil Products.

MORE HIGH OCTANE—Addition of the cat cracker will enable the farmer-refiners to produce gasoline that could easily meet anticipated future octane requirements for both premium and motor grades.

Besides, the new fluid catalytic cracking unit when teamed up with the present UOP two-coil thermal cracker will substantially increase the refinery's gasoline production. Expected gasoline yield is estimated at 71 volume percent based on the crude charge.

The gasoline will have a Reid vapor pressure of 10 lb. and a distillation end-point of 400 deg. F.

LESS FUEL OIL—Once on stream, the new operation will reduce the refinery's production of No. 6 fuel oil significantly. This will be effected by running part of the capacity of the existing UOP two-coil thermal cracker as a viscosity breaker, charging the reduced crude from the vacuum flashing unit. About 20 percent reduction in No. 6 fuel oil output is expected from this operation.

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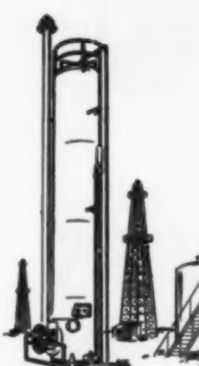

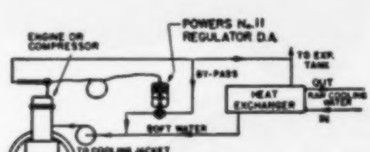

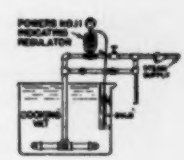

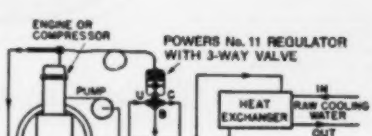

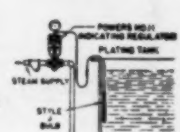

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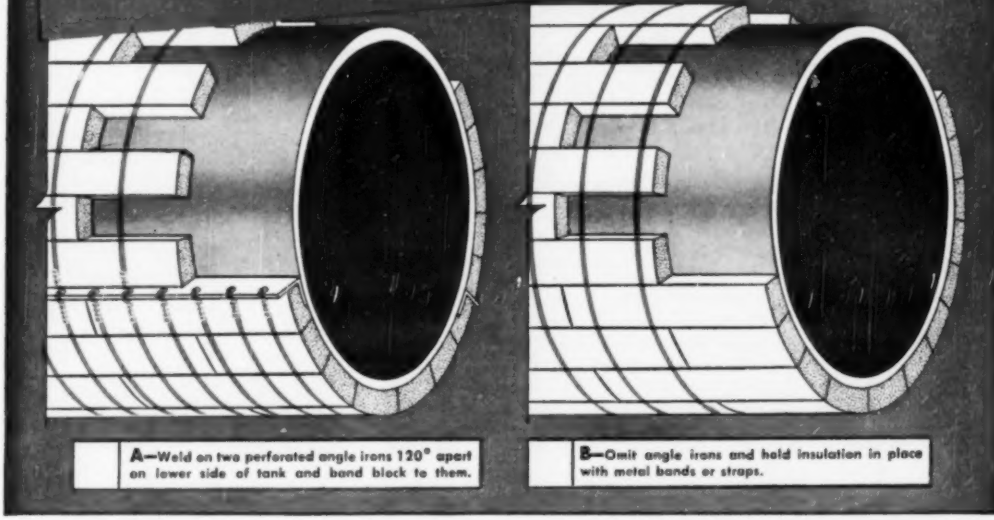
HOW WOULD YOU ATTACH HEAT INSULATION TO THIS HORIZONTAL TANK?

● Horizontal tank 6′ in diameter is to be insulated with 2″ thick 85% Magnesia block. Which of the two methods illustrated would you recommend?



HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

Both methods shown above will hold the insulation on a 6′ tank firmly in place. But on a tank this size, it is unnecessary to go to the extra expense of welding on and perforating the angle irons. The Armstrong engineer recommended the less expensive Method B.

However, on very large tanks, or where extreme vibration conditions are encountered, it is often necessary to additionally support the bottom third of the insulation. Then Method A, or some other means of providing extra support to the insulation on the underside of the tank, would be in order.

Many times a piece of heated equipment can be efficiently insulated in two or more ways. In these cases, an engineer or workman well grounded in the application of heat insulation can quickly choose the best method.

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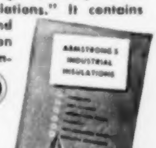

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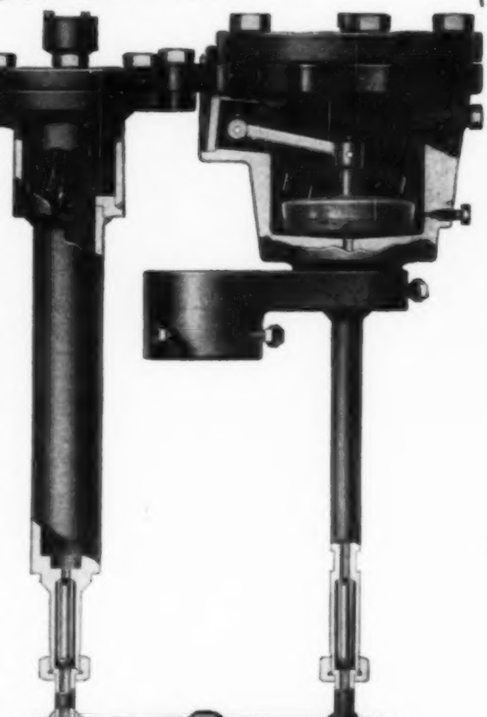

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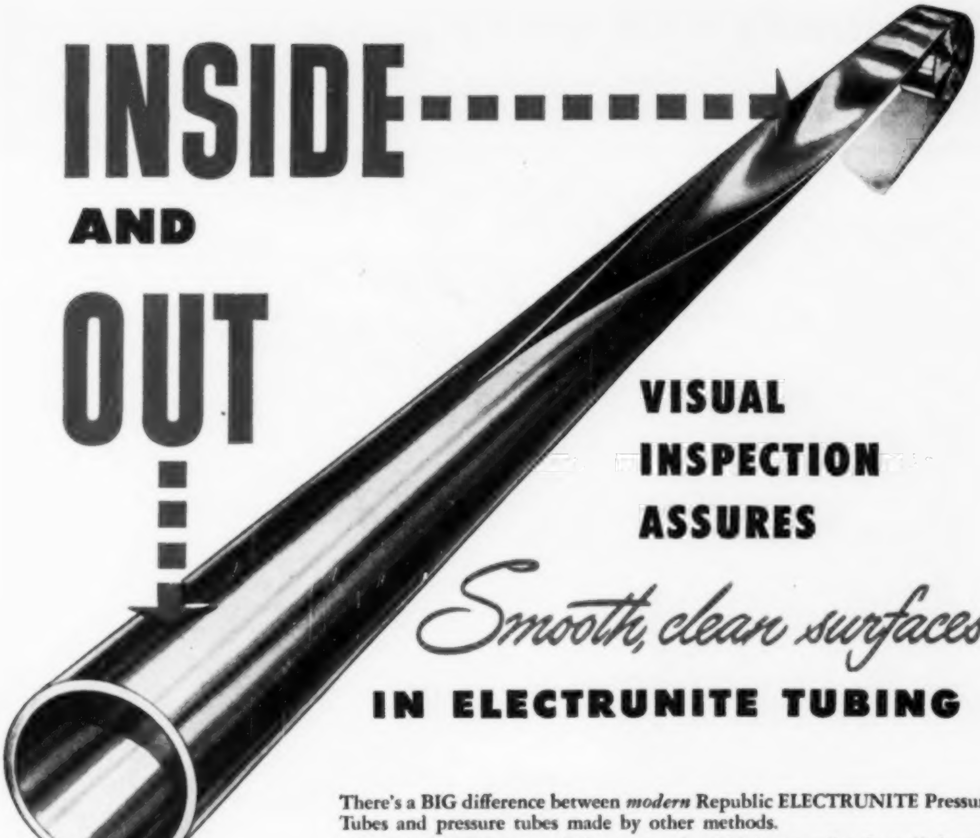

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Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

OCTOBER 1949

Spend to Save

In common with other McGraw-Hill publications, we are currently concerned with increasing emphasis on lower costs and higher productivity. Here is industry's great opportunity for advancing the national economy. Here is the engineer's most challenging responsibility for contributing his specialized knowledge and resourcefulness toward improving the efficiency of plants and processes.

Too often too many of us think of cost cutting as a defense mechanism. Somehow it connotes contraction, restriction rather than expansion of effort and facilities. Yet we all know that in the long run it takes money to make money. We can profit most as we make more and better goods to sell at ever lower prices. So the job of cutting costs in most of our industries means more efficient methods and equipment, more production per unit of expense, whether in time, labor or materials.

With these thoughts in mind, we present in this issue the beginning of a continuing effort to help chemical engineers make their most effective contributions to increased efficiency in the process industries. To spend wisely is to save wisely—a sound slogan for most of us during the months ahead.

By Merit or by Law

Lard producers have been very much disturbed by various competitive situations which threaten to reduce the consumption of this product of the packing house. One of the latest worries has resulted from claims that the use of emulsifiers in bread might result in a lowering of the fat content.

We have not believed that any such result is likely. But the packers took no chances. They proposed, through interested Senators, to require that there be not less than 4 percent of natural fat in bread or pastry, or otherwise it would be declared adulterated. Thus they hoped to accomplish by legal restriction in the Food and Drug Act the requirement for use of lard or other "natural fat" that would preclude alternate shortenings, no matter how meritorious.

That proposal, introduced by Senator Gillette as S. 2432, was knocked out almost as soon as it was presented to the Senate. Now other efforts are taking its place. But, withal, it seems to us that the packers and other lard producers would get farther if greater expenditures were made for research on the possibilities of making lard more attractive to the housewife. Markets achieved by merit will be much easier to hold than those obtained by discriminatory statute.

The Cost of Health

Industry, in the last analysis, pays all of the living costs of its wage earners. It always will. Thus we shall pay directly or indirectly the added costs of any plans for protecting the health of our workers and their families. This gives us a very direct stake in the political controversy over socialized medicine that is just beginning to be important in Washington. It gives us a very real interest in the way the steel industry finally settles its labor problems.

No one has all the answers to the questions we must soon face in this field. But here are two conclusions that seem worthy of at least tentative acceptance:

The American enterprise system and the natural individualism of the American people will not give wholehearted endorsement to mechanized and socialized medicine. It is important, therefore, that the people be guided by facts which will make voters demand the retention of some sort of personalized medical service, at least for all those above the charity class.

While retaining the personalized features of medical service, we must strive valiantly to eliminate those calamity problems which come from unusually high and unexpected medical expenses in the family of moderate income.

We need something for the wage earner and his family like the "deductible" collision insurance we provide for our automobiles. For each wage earner we need some plan that will help out when the aggregate of medical costs in any year exceeds some maximum which is the reasonable upper limit

for medical expense for the family of any given financial status. That should be an insurable item of expense. Those who can help workers and management to establish such a limited health insurance program will contribute a timely service right now to American industry.

Alcohol for Anti-Knock

Alcohol can be used for motor fuel either as a blend with gasoline or to improve engine performance by injection of small quantities into the intake manifold during peak loads. The former use, long proposed valiantly by the chemurgists, still seems impractical of achievement. But injection to reduce knocking and improve performance now seems both practical and, for many motor fleets, to be economically attractive.

The oil industry will have to sharpen its pencils to figure out the economic consequences of alcohol usage as an anti-knock. At the very least it offers something more to sell in the filling station, presumably at a profit. But it may also introduce a new variety of service demands at the same station. It might slightly reduce the total sales of gasoline. More importantly it may make low-octane fuels adequate and attractive to motorists instead of premium grades on which profits may seem greater.

It is not yet clear how the public will take to this auxiliary fuel usage, if at all. But the difficulty of getting enough high-test gasoline increases as the number of cars on the highway with high compression ratios increases beyond all previous records. As the first step in testing this development, an aggressive campaign has already been staged by large fleet operators in the Cleveland area. Work has been underway for some time in the Northern Regional Research Laboratory of the U. S. Department of Agriculture and is currently reported in an interesting bulletin (AIC-240).

It is expected that through such studies the uncertainties and the difficulties in the path of this development may be largely eliminated before the general public demands wide use of injection equipment and auxiliary alcohol fuel. In any event, this development is one that cannot for long be ignored by the petroleum and chemical industries.

"Farmer Victorious"

We quote a thought-provoking paragraph from a publisher's invitation to buy an autographed copy of a book of this title.

"The headlong greed of industrialists in their plunder of unrenewable resources and their utter blindness to the will of the people who decry such ravages, cannot fail to hasten the day when all natural resources must be taken over by the government. Rapidly the day approaches when the farmer will take command and will save for the nation its irreplaceable reserves through substitution of chemically processed agricultural products. Through this good fortune, farm and factory will be made to interlock; whereupon private enterprise and national prosperity will rise to heights never before dreamed."

No, the author is not a Communist or a Socialist or even a Technocrat. He's the distinguished father of chemurgy in America—our old friend, Dr. William J. Hale, with whom so many of us love to argue. We hope to have more to say about the book when our review copy arrives, with or without the distinguished autograph.

Must We Be Blamed?

Agricultural production per farm worker is today from two to ten times as much as it was only two or three decades ago. Adequate supplies of low cost fertilizer and the availability of effective pest-control chemicals are two of the major factors which have made possible stupendous production by limited numbers of agricultural workers. These two contributions of chemical enterprise have probably done as much as the mechanization of agriculture in increasing present and prospective surpluses of farm products.

Beginning late last year there was a precipitous drop in prices for oils and fats. Today tallow is in considerable surplus and new uses are earnestly sought. Some commentators have tried to lay the blame at the door of the soap and oleomargarine industries. Others have pointed out that the rise of synthetic detergents has adversely affected the market for farm products.

But to argue that for these reasons there should be an abandonment of the benefits of science would be both economically and socially absurd. Tremendous contributions and effective application of chemical research and engineering developments represent advantages in labor saving and service value to the people of the world. These advantages must be retained even though they cause inconvenience or hardship temporarily to those who profited from the old situation. This is not the time nor place in which to offer complete remedies or corrections. But it is the appropriate time for us to emphasize one important thing that should not be done.

It is certainly not justified that the relief measures which cushion the impact of these great changes should take such form as to continue old habits and practices that merely aggravate the surpluses. Any benefits for farmers who have surplus problems must be so set up as to discourage and taper off those crops in excessive production. To this extent it is proper to suspend briefly the more drastic effects of the law of supply and demand. But it is neither sensible nor safe to assume that Congress or anybody else can repeal that basic law of human psychology and behavior.

THROUGH HIGHER PRODUCTIVITY, PROCESS INDUSTRIES PLAN FOR

CUTTING COSTS

Here, in a group of six articles, to be followed by other articles in later issues, policy makers in the process industries will find many ideas that will aid in the productivity-raising, cost-cutting job ahead.

CHEMICAL ENGINEERING REPORT—OCTOBER 1949

As the chemical process industries plan for 1950 and the future, they find that all manufacturing industries are facing a common problem—relatively low productivity and high costs. Going back to primary causes, they find that wages have outstripped productivity, and production costs have gone up faster and farther than the selling prices of the products they make. Hence we have had industrial uncertainty, considerable declines in business in some lines, and a modest increase in unemployment.

On a balance point

Now, fortunately, the unemployment trend seems to have started a reversal. Business is beginning to pick up in some industries. If dire things to come is still the prediction of certain economists, others believe the corner has been turned. With good management—and good luck—they feel that a long period of prosperity can ensue. It seems to us that we are on a balance point, where business can go either way. Of course, industry cannot influence many uncertainties in the international situation. And there is still the element of "luck"—the imponderables in economics.

Industry can go ahead

Still, industry's hands are not tied. A concerted effort toward restoring the essential balances between productivity and wages, costs and prices, can go a long way on the road to good management, and toward making certain that the "luck" will be good. If the first job of increasing productivity is taken care of, the other factors should largely fall into line. As a start toward this necessary goal we strongly commend the articles on the following 15 pages.

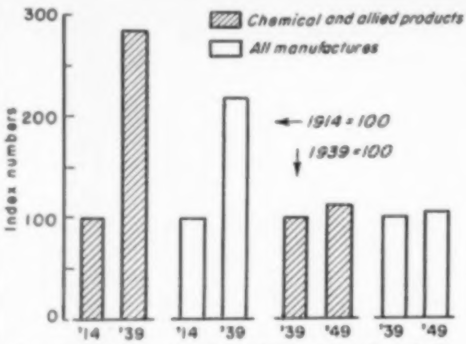


Fig. 1—While manufacturing industries were about doubling productivity from 1914 to 1939, chemical industries scored a three-fold gain. Since 1939 productivity has improved but slightly in both industry groups.

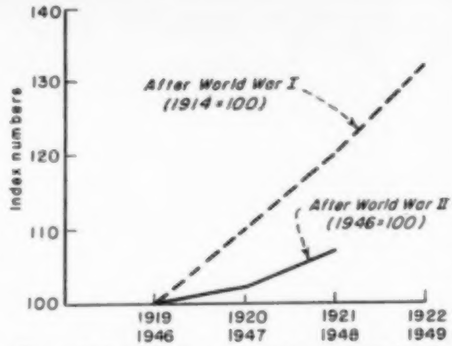


Fig. 3—Postwar effects on productivity of manufacturing industries differed markedly: after World War I productivity shot upward at over 10 percent per year; gain has been slow since World War II.

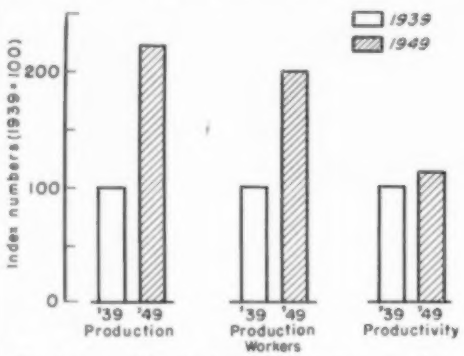


Fig. 2—Since 1939 chemical production has more than doubled, chemical production workers have just doubled, but only a slight increase in output per worker (productivity) has been registered.

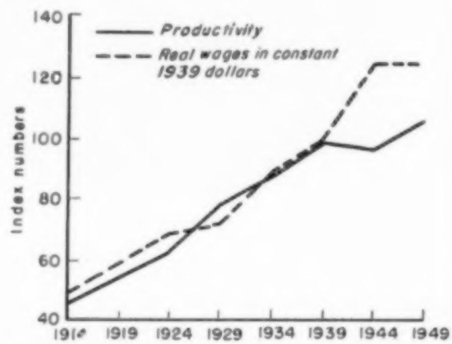


Fig. 4—Productivity and real wages (living standards) advanced together from 1914 to 1939; since 1939 wage advances have put wages well ahead of gains in productivity of manufacturing industries.

Sources: Federal Reserve Board, Bureau of Labor Statistics, Factory Management and Maintenance Magazine, and 1949 estimates by McGraw-Hill Department of Economics.

To Lower Costs Industry Must Raise Its Productivity

Only through increased efficiency and productivity can profit levels be restored and living standards be maintained

PETER FRENCH, Department of Economics, McGraw-Hill Publishing Co., Inc., New York, N. Y.

Is progress in the chemical process industries slowing up?

Chemicals set pace

In the years before the war the chemical industry was one of the pace-setters in improving efficiency. By installing new equipment and introducing new methods and materials, it improved its performance year by year—turning out more production per man-hour worked. While all manufacturing industries roughly doubled their productivity (i.e., production per man-hour) between 1914 and 1939, the chemical industry almost tripled its productivity (Fig. 1).

And cut costs

This outstanding performance by the industry was a major contributor to its growth. It allowed the industry to cut its costs and prices, raise wages steadily, and still to plow back a

majority of its earnings to expand and improve its plants and new equipment.

Helped living standard

The industry's performance in tripling its efficiency also contributed importantly to the steady rise in American living standards. The fact that the United States has the highest living standard in the world is possible only because American industrial productivity is far ahead of other nations. Over-all productivity of American industry is twice that of Great Britain, three to four times the level in Belgium, France, and other European countries, and probably eight times Russia's.

The American worker's higher living standard is possible only because—working with better equipment—he can turn out twice as much in an hour as does his British counterpart, or eight times as much as a Russian industrial worker.

The war, however, sharply set back industry's efforts to increase its efficiency.

War cut efficiency

In the years just before Pearl Harbor, industry improved its productivity at an average rate of better than 3 percent a year. But the war demanded production at any cost. Equipment and plants that had become obsolete began to roll once more at full capacity. Housewives and youngsters with no industrial experience went to work in plants all over the country. Research and development were concentrated on war products. The result: instead of improving its efficiency, American industry actually saw it slip back in the war years. By the end of the war, productivity was well below the 1940-41 level, probably back to about where it was in 1938.

In the postwar years—when pressing shortages of almost everything again encouraged production at any cost—productivity was slow to rise. The war, with all the changes in products and methods and volume of business activity that came with it, upset all the standard methods of measuring productivity. But most economists would agree that it was not until some time in 1947 or 1948 that productivity got back to its 1941 level.

Slow gain now

The war's adverse effects on the ability of the chemical industry to improve its efficiency were greater proportionately than for manufacturing as a whole. Where the chemical industry had been a pace-setter before 1940, its productivity increase apparently was slowed down to about the average of all manufacturing industries.

This comparison can be only a rough estimate. There are, as yet, no precise postwar figures on productivity in either the chemical industry or manufacturing as a whole. At best, the figures cannot reflect changes in products or improvements in quality, and they conceal what may be outstanding records in individual companies or parts of the industry.

But—apart from the comparison with other industries—the rate of progress within the industry itself has slowed down. During the 1930's the industry was improving its productivity at a rate of 5 percent a year. Since 1939, however, the average gain indicated in Fig. 2 is about 1 percent a year.

The lag in chemical industry efficiency has not come because the industry has not spent money on new plants and equipment since the war. The 1949 survey of Business' Needs for New Plants and Equipment, carried out by McGraw-Hill, shows that the chemical industries spent $1.4 billion in 1948 and will spend almost as much in 1949. Moreover, the industry has plans to maintain its capital expenditures at almost that level over the next four years.

Since '45—expansion

One reason for lagging productivity, and perhaps the major reason, is that since the war the industry has had to concentrate on *expansion*. In 1948, for example, 64 percent of its plant and equipment expenditures went primarily to expand capacity, rather than to replace and modernize older equipment and processes. In the years ahead the industry, according to results of the McGraw-Hill survey, plans to put about half of its funds into replacement and modernization. Money spent that way—for example, in converting batch processes to continuous, automatically-controlled processes—can sharply raise the industry's productivity.

Then, too, competition has increased sharply this year. Its pressure can be expected to be still more intense next year. The chemical industry—and all industry—has a much greater incentive to better its efficiency than it had in the years right after the war.

But now—efficiency

Why does industry need to concentrate on raising its efficiency?

Before the war productivity was taken almost for granted. It was considered an almost automatic byproduct of industry's day-by-day operations. Productivity moved up steadily as industry developed and installed better ways of doing things. After the first World War—which also stymied progress in better efficiency for a few years—productivity surged forward. In the early 1920's, for example, Fig. 3 shows that manufacturing industries bettered their productivity at a rate of more than 10 percent a year.

But World War II brought no such surge in its wake. Note the contrast in Fig. 3. Part of the explanation is that the second war demanded a much bigger effort from industry and piled up much bigger shortages. Industry had to concentrate on production—more production at any cost—for years.

Lag must be overcome

The lag is now so great that we can no longer take productivity for granted. To meet the demands on industry for the goods and services that make possible higher living standards, better social welfare services and world rehabilitation, productivity will have to increase.

What has been the effect of the second postwar period on the usual balance between productivity and real wages? Fig. 4 shows what has happened since 1914. Up to 1939 productivity, and real wages (wage rates adjusted for changes in living costs) moved upward in substantial balance. During and since the war, however, wages have gone well ahead.

Does better productivity mean fewer jobs?

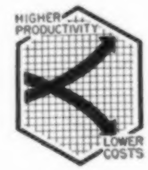
Over the long run—and the chemical industry is a fine example of it—improving efficiency has meant more jobs, not fewer. In the last century, the Twentieth Century Fund estimates, productivity in the United States has been multiplied five times. But in that time our total national output has multiplied 27 times. With about eight times as many workers, each

working about a 40-hr. week instead of a 70-hr. week, the United States is producing 27 times as much as it did 100 years ago. To turn out as much as we do today, with productivity at the 1850 level, would require three times as many people, each working almost twice as many hours as at present.

The evidence is clear: In the long run investment in new plants and equipment raises productivity, raises living standards, and creates new jobs. For industry, it lowers labor costs and prices and expands markets.

In the short-run capital investment is just as important. Over the years the record shows that the United States has had good business generally when industry was investing at a high level in new plants and equipment. As capital expenditures go, so goes prosperity.

Management Engineering Can Pay Off



A timely article describing the organization of a management engineering department, and how it cuts costs

JACKSON D. LEONARD, Senior Engineer, E. I. du Pont de Nemours & Co., Houston, Tex.

In the last decade, plant management has faced an imposing array of difficulties in performing its task of "producing the maximum of good quality production at lowest possible cost." Governmental controls on materials, the increasing unionization of labor, increased cost of materials and labor, price controls on products, and increased taxes are but a few of the factors that have increased production costs.

What it is

In order to offset these external adverse cost influences, management has been forced to utilize every known "tool," and develop some additional new tools as well. These devices, both new and old, have been grouped together under the term "Management Engineering."

Management engineering is known in piecemeal fashion by most of the chemical industry under the names industrial engineering, process engineering, etc. These groups solve individual problems, but few companies have made any attempt to build an integrated team to attack the cost problem.

Its job is to save

Briefly, management engineering is the art of refining, improving, and reducing the cost of operating an established chemical process; the cost sheet is its direct measure of success and progress. Improved quality of product, better working conditions, and improved safety are its secondary results, and sometimes count for more than the cost sheet dollars.

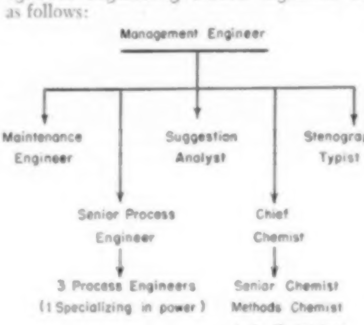
Status in plant

To illustrate more fully the place of the management engineer in modern chemical industry, let us examine in detail how a modern management engineering section is organized and functions. First, and most important, is the organization position. In order to be most effective, the management engineering group must enjoy equal status with the other departments in the plant.

Such organization would insure that technological ideas and improvements would share equal consideration and discussion along with the other important phases of plant operation, and would also have an equal voice in the formulation of overall plant policy. Too often, the technical departments are subjugated to the production department.

Internal organization

Having established the equality of the management engineer, the next most important step is to have the internal organization of the department arranged to effect maximum performance. The number of people in such a group will, of course, vary with the size and complexity of the plant. However, a rough rule of thumb which will hold true for many chemical plants, is that one technical engineer can be effectively employed for each $1,000,000 of investment. Thus a $10,000,000 plant employing 500 to 600 people would have a management engineering section organized about as follows:



Department grouping

Note that the chief chemist and control laboratory are placed under the management engineer. This is done for several reasons: first to insure that equally good service of high caliber will be extended without discrimination to all the operating departments, and secondly, to insure that technical samples are serviced as needed. All too often, the control laboratory is placed under the direction of the operating department, so that technical samples are delayed, or hurriedly "squeezed in" with other

work so that a technical program is delayed, or based on poor or inadequate analytical results.

A necessary part of the organization picture is the type personnel needed, and their salary scale. The evaluation in Table I represents the writer's own opinion based on field experience. Obviously, some plants will require more specialized personnel, but this tabulation will fit a majority of present day plants.

Cost vs. savings

Thus, the minimum annual cost of the organization recommended for the average $10,000,000 plant would be about $48,000 exclusive of the chief chemist and control lab technicians whose costs would be largely chargeable to operating expense. The minimum total experience or know-how would be 48 years plus 39 years of college educational training. The minimum amount which a well coordinated group of this size should save (or reduce costs by) would be $250,000, and the maximum about $500,000 per year. So that on a straight dollar basis, it can be readily seen that management engineering is a profitable business. When the other intangible benefits such as improved product quality, improved working conditions, and improved safety are added on, the picture becomes doubly attractive.

How job is done

Let us now examine in some detail how results such as these are obtained. As a first step, the manufacturing costs of each operating unit are carefully analyzed, and standard cost goals developed for each separate item of cost. This initial analysis will require a detailed study of the process, calculation of theoretical consumptions and units, and comparison against past performance. This survey may reveal some alarming inaccuracies in cost accounting and plant charging procedures. In a certain plant where such a study was made, the cost books showed that three interrelated processes A, B, and C were all just moderately profitable. When the true cost picture was untangled, Process A was found to be very profitable, Process B moderately so, while Process C was actually a serious money loser. The attention of the management engineering group was immediately focused on Process C with the result that within a year's time, sufficient improvement had been made to bring it onto the "black" side of the ledger. At the same time, some much needed capital expenditures which it had been previously impossible to justify for Process A, were now easily justified, and the business in this commodity greatly expanded. Obviously, such a cost study can only be properly performed by an experienced process engineer as the establishing of yields, budgeting of utilities and labor, standardizing packaging and shipping costs requires technical skill, common sense, a thorough knowledge of plant operations, and good judgment. All too often so-called standard costs are established by an accountant, clerk, or top executive who has no real knowledge of the operation and its problems, and no real knowledge of whether the standards are right, or wrong.

Monthly comparison

Once the initial standard costs for each operation have been established, and the basis for each cost element thoroughly explored, then each month the standard costs must be reviewed and revised for the coming month, and a comparison made between the standard and actual costs for the past month. Deviations of the actual cost from standard on each cost element amounting to $50 or more should be investigated and the reason for the deviation determined. This monthly comparison can be performed in a matter of a few hours, but can succeed in paying large dividends.

Table I—Management Engineering Personnel

Position	Preferred Minimum Education*	Desirable Experience	Salary Range
Management engineer	B.S. in Ch.E.	10-15 years varied plant experience including at least 5 yr. production supervision.	$8,000-$12,000
Senior process engineer	B.S. in Ch.E	7-10 years varied plant experience including at least 3 yr. production supervision.	$6,000-$8,500
Maintenance engineer	B.S. in M.E.	7-10 years varied plant experience including at least 3 years in maintenance supervision.	$6,000-$8,500
Process engineer	B.S. in Ch.E.	3-5 years varied plant experience including at least 2 yr. production supervision.	$4,000-$6,000
Chief chemist	B.S. in Chem.	7-10 years varied laboratory experience including at least 3 years in a plant control laboratory.	$6,000-$8,500
Senior chemist	M.S. or Ph.D. in Chem.	3-5 years varied laboratory experience.	$5,000-$7,000
Methods chemist	B.S. in Chem.	2-3 years varied laboratory experience including at least 1 year in a plant control laboratory.	$4,000-$6,000
Suggestion analyst	B.S. in Ch.E.	Same as process engineer.	$4,000-$6,000
Lab. technicians	High School	None needed.	

* Note that in only one case is a degree higher than a Bachelor's recommended. It is believed that plant experience is the best "higher education" for management engineering work, and that Masters and Doctors degrees are chiefly of value in research or development work.

After the cost standards and comparisons have been started for each process, the real job of cost reduction is begun somewhat along the lines of Table II.

Working with suggestions

In addition to this direct cost sheet attack, the suggestion analyst is used to handle all supervisory and staff member suggestions. If a suggestion system of this type does not exist, it should be established as many fruitful ideas will be advanced by alert supervision. The management engineering section is the best qualified department to handle these suggestions and get the utmost benefit from them for the company, and also the suggestor. Adequate rewards should be paid to all successful suggestors in order to stimulate the flow of these improvement ideas.

The advantages of such a coordinated management engineering program will show up first on the cost sheet, but will also appear in the form of improved morale and company loyalty. Likewise, the maximum results will be obtained for the least expenditure of money.

Table II—Program for Cost Reduction

I. Raw Materials (Process Engineers, Senior Chemist)

(a) Yields are first carefully studied to determine possible improvements; (b) Substitution of cheaper materials in place of those being used, or chemical refinements to the process to decrease consumptions are made the prime responsibility of the senior chemist who can pursue an orderly program of exploration along the indicated lines; (c) Better means of unloading and handling the raw materials into process are another savings source.

II. Operating Expenses

1. Labor (Process Engineers)

(a) Standard operating labor requirements are determined in cooperation with operating supervision. Once established, a daily time office report will quickly show up any serious deviation, and permit rapid correction. (b) Long range studies to mechanize or eliminate high labor portions of the operation are begun.

2. Utilities (Process Engineers, Power Specialist)

(a) Metering of all major utilities such as electricity, steam, fuel oil, water, vacuum, and compressed gases forms an ideal basis for establishing utility budgets for eliminating waste; (b) Where metering is too expensive, a system of spot checking can be developed and incorporated into operating procedures to effect reductions; (c) In addition, recovery and reuse of waste utilities can also be extremely lucrative.

3. Control Laboratory (Process Engineers and Methods Chemist)

(a) Statistical analysis plus common sense review of analytical requirements can oftentimes effect remarkable savings; (b) Review of the analytical methods by the methods chemist can result in shortening and simplifying them.

4. Maintenance (Maintenance Engineer)

(a) In the average chemical plant, maintenance expense comprises an appreciable percentage of the unit cost, and thus deserves special treatment. In recent years, several special methods have been developed to reduce maintenance costs. Best of these is planned maintenance. This is a newly developed method of coordinating the activities of the maintenance department so that the proper craftsmen, the right tools, and the necessary materials arrive on the job at the right time to achieve necessary repairs; (b) A second "tool" is maintenance engineering which, briefly, consists of individual studies of maintenance methods, organization, and tools; (c) Both of the foregoing plans along with a good salvage and reclamation operation can do wonders for maintenance costs.

5. Packages (Process Engineers)

So many improved packaging methods, and new types of containers have been developed in the last 5 years by the industry leaders, that it is safe to say that much of the industry is out-of-date. Yet although this is one of the most important phases of the unit operation, all too often it is completely ignored. Good packaging can sometimes sell the product when all else fails.

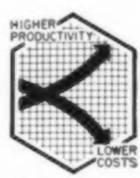
6. Shipping (Process Engineers)

New material handling techniques, if properly applied to the warehousing and shipping end of the process, can effect substantial savings, and improve service to the customers.

III. The Overhead Block (Process Engineers)

The overhead block on the average cost sheet usually carries some strange and wonderful items in addition to the usual taxes, insurance, depreciation, clerical, supervision, etc. A careful combining of each of these items can sometimes produce golden results: overlapping insurances, fees for legal services covered by insurance, unadjusted depreciation, etc. are but a few of the items most often neglected to the detriment of the cost sheet.

Revamping Offers First Aid To Marginal Processes



Processes which no longer pay owing to labor cost increases can often be revamped and returned to profitable operation

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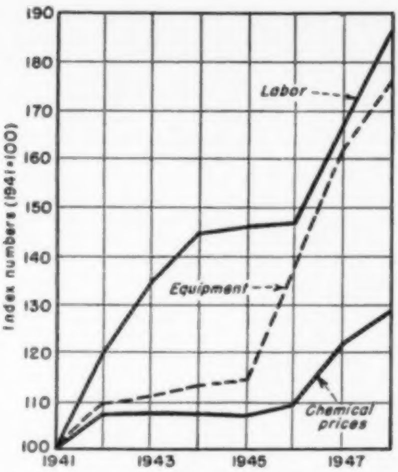
In the period since the war the trends in costs and prices have been such that many chemical manufacturing processes have become marginal. Labor costs in particular have increased, while selling prices have by no means kept pace. Unless steps have been taken to correct the disparity, in many cases this has meant the serious shrinkage or even disappearance of profit margins. Fortunately, as this paper will show, a solution can be achieved for most such processes through "revamp engineering," with the result that the percentage of labor entering into the manufacturing cost can be substantially reduced, usually with only very minor expenditures for additional equipment.

How has the problem come about? Many of the processes that have passed from a profitable status in recent years can attribute their deficits to the changing relationships between the cost of chemical plant labor and the selling prices of chemical products. In certain other instances the changing cost of chemical equipment may also be an important consideration. To show the relations between these various changes, the accompanying plot gives price indexes for labor, products and equipment in



Price indexes for chemical industry labor, equipment and products show why marginal processes are being squeezed between high cost and low return.

the chemical industries for the period 1941 to 1948. The chemical prices cited are from *Chemical Engineering*'s Chemical Price Index, the wages from the Bureau of Labor Statistics' data for Chemical and Allied Industries, and the equipment costs from the Marshall and Stevens Indexes of Comparative Equipment Costs. For convenience all have been reduced to a base of 1941 = 100. In this plot discontinuities in the rates of increase reflect the wartime governmental regulations.

Cost vs. selling price

To test the effect of these price trends consider as a typical example the manufacturer who buys raw materials at chemical index prices, adds a certain amount of processing and then sells the semi-finished materials on a market which has undergone the same price fluctuation as the raw materials. The changing cost of labor has greatly exceeded the changing selling price of chemicals and the differential is reflected by reduced profits. The greater the percentage of labor in the total manufacturing cost, the greater is the effect of the differential changes on the operating economy. There are two ways in which these changes affect the chemical manufacturer: first, in the operation of an old process and secondly in planning a new one.

Profits are down

With regard to the operation of old processes, compare the profitability of continuing to operate an average process today which was designed in 1941. For a breakdown of operating costs as a function of net sales, the results of a broad survey* are available covering the analysis of 366 chemical corporations through their profit and loss statements and data obtained from the FTC and SEC. The average profit and loss statements for 1941 and 1947 are given in Table I together with a breakdown in percentages. Data for 1948 are not sufficiently complete at the present time to permit their inclusion but they may be estimated with sufficient accuracy for present requirements. In 1941 labor accounted for 12.6 percent of the total sales breakdown and the gross profit was 16.4 percent. In 1947 labor and materials had risen, although sales expenses were lower and gross profits declined to 11.2 percent.

Large concerns dominated

The figures in the averages of Table I do not correspond too closely with those which might be expected from the indexes in Fig. 1. For example, the labor cost in the average shows an increase between 1941 and 1947 of only $15.8 \times 100/12.6 = 25$ percent, whereas the labor index rose 67½ percent in 1947 and 87½ percent in 1948. But at least part of the discrepancy can be traced to its origin. The data of Table I represent a large number of companies and are undoubtedly dominated by the dollar volume of the operators of the large continuous processes who were operating many of the same installations in 1947 as in 1941 but with higher annual output during 1947. Although they paid the same basic hourly labor rate, their ability to increase continuous processes to full capacity without a proportionate increase in the number of labor hours has reduced the average labor cost below the value indicated in the index.

What of smaller company?

To see how the smaller processes have faired in the face of the changing indexes, consider the case of a batch operation having labor requirements proportional to the total hours of operation at full capacity. This also includes the premise that batches be run only when the demand is sufficient to warrant operation at full capacity.

During the period from 1941 to 1948 the chemical price index rose only 29 percent. If the same quantity of the same materials were sold by the manufacturer as in 1941 it would have resulted in gross 1947 sales of \$2,040,000 as shown in Table II, as against \$1,581,000 in 1941. Under the premises above, if other manufacturing and sales costs had been kept in the same proportion as in 1947 (the last year for

Table I—Averages of Survey of 366 Chemical Companies

	1941		1947	
Net sales	\$1,581,000		\$2,354,000	
Costs				
Material	727,000	(45.9%)	1,183,000	(49.0%)
Labor	199,800	(12.6%)	373,000	(15.8%)
Fixed charges and other mfg. charges	111,200	(7.1%)	186,000	(7.9%)
Total manufacturing costs	\$1,038,000	(65.6%)	\$1,712,000	(72.7%)
Sales and administration	284,000	(18.0%)	378,000	(16.1%)
Gross profit	259,000	(16.4%)	264,000	(11.2%)
Total	\$1,581,000		\$2,354,000	

Table II—Extrapolation of 1941 Data to 1948

	1948	
Net sales	\$2,040,000	
Costs		
Material, \$727,000 × 1.29	937,000	(45.9%)
Labor, \$199,800 × 1.875	374,000	(18.3%)
Fixed charges and other mfg. charges	161,000	(7.9%)
Total manufacturing costs	\$1,472,000	(72.1%)
Sales and administration	328,000	(16.1%)
Gross profit	340,000	(11.8%)
Total	\$2,040,000	

* Unpublished survey courtesy of R. S. Aries and Associates.

Table III—Effect of Price Trends on a Typical Batch Process

	1941		1948	
Net sales	$1,581,000		$2,040,000	
Costs				
Material	407,800	(25.8%)	527,000	(25.8%)
Labor	519,000	(32.7%)	974,000	(47.7%)
Fixed charges and other mfg. charges	111,200	(7.1%)	161,000	(7.9%)
Total manufacturing costs	$1,038,000	(65.6%)	$1,662,000	(81.4%)
Sales and administration	284,000	(18.0%)	328,000	(16.1%)
Gross profit	259,000	(16.4%)	50,000	(2.5%)
Total	$1,581,000		$2,040,000	

which figures are available), the material cost, percentagewise, in 1948 would be the same, but labor would have risen from 12.6 to 18.3 percent, while profits would have declined from 16.4 to 11.8 percent. Note that in 1941 the averages of the chemical industry show that labor represented only $12.6 \times 100/65.5 = 19.2$ percent of the total manufacturing costs for all processors while in some batch processes labor may represent as much as 50 percent or more of the total manufacturing cost.

Profits approach zero

Referring to Table III, for a batch process in which labor was 50 percent of the total manufacturing cost in 1941, and using the same ratios as in 1947 for the other costs, gross profits would have declined to 2½ percent. The continuation of an operation with so small a gross profit may lead to a deficit after taxes are deducted. If the batch process is operated by a large processor who also operates continuous processes, the deficit on the batch process is apt to be even greater. And if a processor has increased capacity since 1941 by adding successive batch installations similar to those in operation in 1941, the influence of the changing trends is considerably amplified.

What does this mean in terms of present day plant operation? Should the equipment of several smaller operations be abandoned entirely in favor of a larger process requiring new capital outlay? There appears to be little favorable support for such a move at the present time since the abandonment of equipment represents a decline in company net worth. The recapitalization of a process may not be feasible either, since it is based on the return in terms of company net worth, and the cost of chemical equipment has risen almost as sharply as labor. Another alternative is the discontinuation of a small process altogether, but this too requires careful consideration. To the small operator the discontinuation of a process may be equivalent to a partial suspension of business and loss of good will. The large operator, on the other hand, can scarcely benefit from discontinuing a small process unless other costs can be dropped proportionately to offset the reduced sales of the company. Processes providing accommodation and specialty products which do not follow the chemical index are naturally excepted.

Solutions can be reached

As already hinted, there is a solution to the problem which deserves far greater acceptance than present activity indicates. Since the most important trend factor in profitable operation has been the percentage of labor entering into manufacturing costs, it is this labor percentage that must be improved. It is possible to reduce the labor requirements by transforming small processes one step higher in "continuousness," as from batch to semi-continuous, or from semi-continuous to continuous operation. In continuous processes the percentage of labor can be reduced by increasing the operating capacity of an existing continuous process. By these means an opportunity presents itself for overcoming the unfavorable influence of the indexes. If only a portion of the equipment need be replaced in effecting the transformation, it is highly probable that the increased fixed charges will be offset by reductions in the cost of labor.

No simple formula

In May 1945 *Chemical Engineering* published the results of an extensive survey on processing. This report summarized the controlling processing factors entering into the solution of a manufacturing problem through the use of a batch, semi-continuous or continuous process. The findings emphasized that any conclusion resulting in the selection of a batch, semi-continuous or continuous process hinges upon a large number of variables—of which the important ones are discussed below—and cannot be determined by a simple formula.

But costs influence decision

As the foregoing analysis has shown, an additional factor has since come into importance. This is the influence of the primary cost trends—labor, chemicals and chemical equipment—on the selection of the most favorable type of process. Although the data are not as complete as desirable, it has been demonstrated that a process selected on a sound basis in 1945 or before may be operating today at a loss. The loss is usually greater for small capacity processes, whether operated by large or small manufacturers. In fact, the larger manufacturer who operates several small processes without close accounting on each of them may find his profits severely drained by these small losing process units. Because their cost is obscured by over-all operations they may pass from credits to debits without attracting attention unless subjected to accurate accounting controls.

More continuous processes today

For many years it was felt that continuous processing was adaptable only to the larger operations, and batch processing to the smaller. These generalizations were and are substantially correct although they shed no light on the economic dividing point between large and small processes. Since the costs of chemical labor and equipment have risen so much more rapidly than chemical selling prices, generalizations on size can no longer be used to define the range in which continuous and particularly semi-continuous processes are applicable. Today the roster of continuous and semi-continuous processes includes numerous manufacturing operations which only a few years ago were invariably set up as batch operations.

Unfortunately, comparison between the different methods of processing cannot always be reduced to an identical basis. The products of alternative batch and continuous processes are not always the same and some of these differences may preclude all of the general factors from further consideration. The product of a continuous process remains relatively uniform with time if the feed stock remains uniform.

In batch distillation the initial overhead product contains a greater proportion of the volatile components than the product coming off later in the same run. As in certain cases of animal and vegetable oil refining, the overhead fronts may command a premium market price. Continuous distillation, on the other hand, does not afford an initial product of comparable premium grade since the overhead product is uniform. The premium grade may be attained, however, if a considerably greater sum is spent on utilities and elaborate apparatus. When the product is the bottoms of a distillation rather than the overhead, the emphasis is placed on the final rather than the initial stages of the operation. If the bottoms product shows instability as the still temperature increases, the advantage of the brief hold-up in a continuous operation is apparent.

Capacity favored by continuity

It is well known that in most processes the carrying capacity of continuous equipment per dollar of investment exceeds that of batch equipment. For example, a batch treating vessel having a retention of 5,000 gal. per hourly batch—which is nearly the size limit for non-atmospheric batch processes—is replaceable by a continuous apparatus having a flow area equivalent to a 3 in. IPS pipe. In fact, one sharp distinction occurs between processes which will ultimately be scaled up to 5,000 gal. per batch, and those which might require even larger batches to provide the desired daily capacity. Also, when planning the capacity of a projected process the anticipation of a 100 percent future expansion can be incorporated into the original design of a continuous process at an increased cost of only about 25 to 40 percent. In batch processes, however, an expansion of 100 percent may entail an almost proportionate increase in cost although the decision to add capacity may often be made only as required.

Weighty factors

Furthermore, larger continuous plants may be operated without increased labor, although almost proportionate man hours must be added for batch expansion. Others factors, too, have considerable weight in selecting the type of process, such as the versatility of the equipment and annual hours of use, the requirement of curing or reaction time or other hold-up exceeding about 15 min., the continuous availability of raw materials, and the volume and continuous demand for the product. Still other influencing factors are: the quantity of product susceptible to spoilage, the cost of going on and off stream, comparative problems of control, storage, fractional capacity range, quality differentials inherent in the type of process, utility peak loads, wages and labor overtime, etc.

Revamping economical

The possibilities for revamping processes are innumerable. Much batch equipment can be reused because it is oversized by comparison with equipment required for the next upward step in process gradation. When a process is revamped to make it continuous, it is often found that only 10 or 20 percent of all of the equipment represents a bottleneck to increased capacity. By replacing only the bottlenecks the capacity may be increased by as much as 25 or 50 percent with a small outlay.

By reason of erection, an erected piece of equipment is a more valuable commodity than the equipment uninstalled, exceeding the fabricated equipment cost by 25 percent or more, depending on size, and whether field or shop fabricated. Considerable revamping may be engineered without dismantling erected equipment.

Capacity and functions

Revamp engineering usually falls into two main classes: (1) changes in capacity and (2) changes in function. With respect to the former, the component pieces of equipment on well designed processes generally contain a liberal factor of overcapacity. This is also true of the utilities and utility lines such as steam, water and power. When the capacity of an existing process is to be increased, the ultimate capacity can best be determined by extrapolating test runs at partial capacities.

This is particularly true for distillation and absorption equipment where additional capacity may be obtained by changing caps and weirs alone. The ultimate capacities of heat transfer equipment can be determined either from experiment or by calculation. Pumping capacity is rarely a bottleneck although it is the simplest factor to correct, since pumps usually represent less than 5 percent of the total value of average installations. Deficiencies in the carrying capacities of interconnecting lines and fittings are also corrected readily by substituting a pump having not only increased capacity, but also increased head. Qualitative instrumentation and control requires only a minor modification of the original instruments, although somewhat larger changes are usually required on volumetric measurement and control apparatus.

Double for 20 percent

A typical analysis of revamp jobs on commercial distillation assemblies shows that capacities in representative units can be increased by 25 percent at a cost of only 5 to 10 percent of the original erected cost of the installation. Capacity increases as great as 100 percent can be obtained by altering internal designs while the original equipment remains in place. The cost of a 100 percent capacity increase usually will not run more than 15 to 20 percent of the original erected cost of the installation. In a large number of instances the required changes in capacity can be effected simply by supplementing existing heat transfer equipment.

Vital engineering service

When changes in process function are undertaken it is possible to effect even greater economies. For example, an absorber-stripper recovery system can be converted into a precise fractionation assembly for as little as 5 to 10 percent of the erected cost of new equipment. Naturally the laws applicable to revamping are more complex than those applicable to straightforward process design. Many factors which are ordinarily design variables are fixed during revamping by the existence of some or all of the equipment to be used. For this reason revamp engineering requires even greater experience than process design, but experience in design is the principal requisite for effective revamping. Hence we must conclude that revamping must now be elevated to the status of a vital engineering service, rather than be regarded as the stepchild of plant maintenance.

COST CUTTING CHECK SHEET FOR

E. S. COLDWELL, *President*

Ford, Bacon & Davis, Inc., New York, N. Y.

American industries – process industries included – are in a period when profit ratios have been seriously reduced. Costs have gone up more rapidly than selling prices. Break-even percentages have increased – sometimes sharply – and good earnings today hang precariously on the maintenance of high volume.

Management is now faced with a double-barrelled problem: How to reduce unit costs and, at the same time, to increase productivity. Industry must batten down against the chance of rough weather ahead. It must be prepared for the possibility that prices and sales may decrease rapidly while wages may fall slowly, if at all.

This is not to predict that a serious recession is ahead. It is rather a case of insurance bought, not in expectation of fire, but as protection if the unexpected occurs. Once unit costs have been trimmed and productivity improved, a company is doubly insured – not against recession alone but also against the keener competition that is certainly ahead.

Close and critical scrutiny of every element that enters into the over-all cost of doing business is the essential ingredient in any cost reduction program. What are the steps in such a scrutiny? Every progressive management will recognize them. Still, such a stock-taking can be arduous, particularly in view of the well known difficulty of seeing the forest for the trees.

Aware of the harassed executive confronted with today's mounting problems, we consider it appropriate to offer a list of factors which are applicable to most organizations. It is to help in organizing a realistic effort and to avoid overlooking some obscure, or possibly too obvious, point that this cost cutting check sheet has been prepared.

	Now Being Studied	New Study Required	Not a Problem
BROAD POLICIES			
1. Have primary aims and objectives been reviewed recently? Elementary as it may seem, companies sometimes lose sight of primary aims and long-range objectives. Review promotes thinking. It helps to settle such questions as: how to operate in case of a general drop in business activities; whether to go into supplementary and related lines; whether to plan for expansion or contraction; whether to decentralize or to integrate existing facilities.	☐	☐	☐
2. Should outside viewpoints be sought on over-all cost reduction problems? Impartial analysis by outside engineers often uncovers information that may be obscured by familiarity or a variety of other factors. The objectivity of an outside appraisal often leads to an unexpected pay-off.	☐	☐	☐
3. Has decentralization been considered? Shifts in market or in raw materials supplies; better labor reservoirs; more favorable freight situations; delineation of responsibilities, may point to decentralization.	☐	☐	☐
COMPANY ORGANIZATION			
1. Does the company organizational set-up fit today's problems? Lines of authority must be short, direct and definite, with overlaps eliminated, if essential teamwork is to be achieved. Executives relieved of the job of coordination can do a more effective job of managing and long-range planning.	☐	☐	☐
2. Is the present departmental setup best for present needs? Changes in products, markets or other factors may have outmoded the allocation of departmental functions. Grouping of jobs, activities and departments may no longer be logical.	☐	☐	☐
3. Have job definitions been clearly established? Personnel can be classified by job definitions that outline responsibilities, authorities, duties. This deals with functions and activities, not appraisal of individuals; it improves morale, encourages initiative, multiplies abilities, curbs dissatisfactions.	☐	☐	☐
4. Can personnel policies be improved? If unit costs are high and productivity is low, personnel policies may be at fault – morale and loyalty may be lacking and labor turnover may be excessive.	☐	☐	☐
MANAGEMENT CONTROLS AND RECORDS			
1. Have company records as a whole been closely scrutinized? Those relating to activities, costs and results should be specially analyzed to reveal trends, weak spots, high cost products, substandard performance in certain departments.	☐	☐	☐
2. Are sales forecasts and production schedules based on adequate and accurate information? Methods of securing data for forecasts need continuous review. Checks of accuracy must be made against actual results in sales, costs and profits.	☐	☐	☐
3. Are sales and production planning closely coordinated? Production planning provides the foundation for realistic production control. Without effective coordination with sales forecasting, accurate production control is impossible.	☐	☐	☐
4. Is inventory control realistic and effective? Less obvious than control of purchases, inventory control must be timely and accurate; proper balance must be achieved between various item requirements and relation to sales.	☐	☐	☐
5. Do company reports on which management decisions are based accomplish the job intended? Sometimes reports become unwieldy, come too late for effective use, are improperly or incompletely applied. Sometimes they tend to replace head-work with paper-work.	☐	☐	☐

CHEMICAL PROCESS INDUSTRIES

Now Being Studied | New Study Required | Not a Problem

MARKETS AND PRODUCTS

1. Have present products been subjected recently to effective market research? ☐ ☐ ☐
Market research can furnish profitable information: sales potentials; new consumer trends that may call for changes or new attitudes; geographical shifts in markets; competitors' practices; company's position in competitive market. It may indicate whether pricing policies and trade methods are faulty; whether certain products are "weak sisters;" whether others have cyclic or seasonal demands.

2. Is product research being devoted both to present products and to potential new ones? ☐ ☐ ☐
Such research not only establishes the need and sales potentials for new products—it also points up existing products that require improvement, modification or elimination from the line. It may indicate the need for diversification or simplification; for new raw material sources; for better processes yielding higher quality.

3. Does process research have an important place in the research budget? ☐ ☐ ☐
New processes for new products and better processes for old products can stem only from effective process research and development. Both the aim and the result should be lower production costs; more efficient use of labor, materials and utilities; improvement in product quality; saleable products from former wastes.

PRICING, PROMOTION, SELLING AND DISTRIBUTION

1. Are products priced correctly for the market? ☐ ☐ ☐
Pricing requires close study of break-even points. These have risen because price-volume-profit relations have been upset by changes in the ingredients. Today a price cut may not increase volume sufficiently to produce an equal or greater profit. Conversely, although price increases are now generally frowned upon, an increase may not cut volume proportionately.

2. Can break-even points be lowered by technological improvements or better management controls? ☐ ☐ ☐
Direct and indirect costs can be affected by a search for technological improvements. Indirect costs can be controlled by management. Variable costs do not necessarily change directly with volume, and "fixed" costs can sometimes be "unfixed."

3. Are promotion costs and selling expenses in line with results? ☐ ☐ ☐
Perhaps poor results are caused by efforts extending beyond profitable customers or natural sales or geographic areas. If so, concentration of effort should be redirected. Sales performance and promotion costs can be controlled. Regional sales quotas can be gaged by market research and results brought in line with expectations.

4. Are packaging and distribution costs as low as possible, consistent with other requirements? ☐ ☐ ☐
Packages sell consumer products in most industries. However, in bulk process industries, improved economy in packaging and in distribution can yield handsome dividends.

SUPPLY PROBLEMS

1. Can supply sources be improved? ☐ ☐ ☐
Present raw material sources may be playing out or additional processing may be needed to overcome poor quality. Perhaps alternate raw materials will reduce costs, improve the product, or make supply more dependable.

2. Should raw materials be produced or purchased? ☐ ☐ ☐
Sometimes it may be advisable to purchase raw material sources; however, economic feasibility should be carefully investigated: the overall investment, return on investment, ability to support production, and a host of other basic and special features.

PRODUCTION AND HANDLING

1. Should improved processes, perhaps continuous rather than batch, be sought? ☐ ☐ ☐
Replacement of old processes may be advisable. Modern processes usually increase the yield and generally reduce direct costs. However, the effect of the indirect costs, which may increase, requires complete analysis.

2. Can use of utilities be made more economical? ☐ ☐ ☐
Direct wastes of steam, power and refrigeration are often easy to uncover and correct; better scheduling of operations can reduce purchased utility demand charges.

3. Do production bottlenecks prevent an economical expansion of output? ☐ ☐ ☐
Many processes have bottlenecks which can be eliminated at small cost, allowing output to increase, virtually without increasing fixed or labor charges.

4. Can materials handling be improved? ☐ ☐ ☐
Although process industries usually devote less operating expense to materials handling than industry in general, handling is still one of the most fertile spots for cost reduction. Not only obvious improvements should be sought, but also the obscure. Plant and equipment layout should be scrutinized for rearrangements; automatic methods should be studied; various handling methods weighed, one against the other, and the most economical selected for each particular operation.

This list does not attempt to cover the entire scope of cost reduction. It may, however, open fresh channels of thought, encompassing special problems of the reader's own organization.

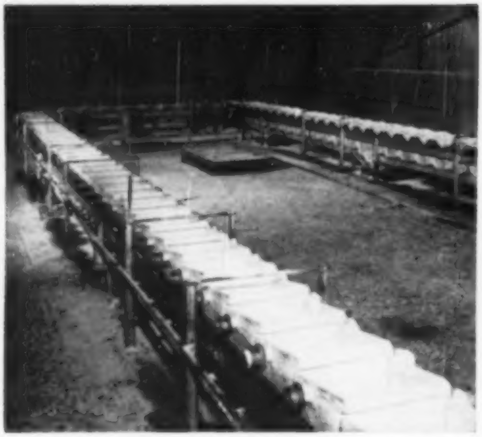


Fig. 1—The runaround "Side-Kar Carrier" is especially suited to fragile materials such as minute hollow spheres.

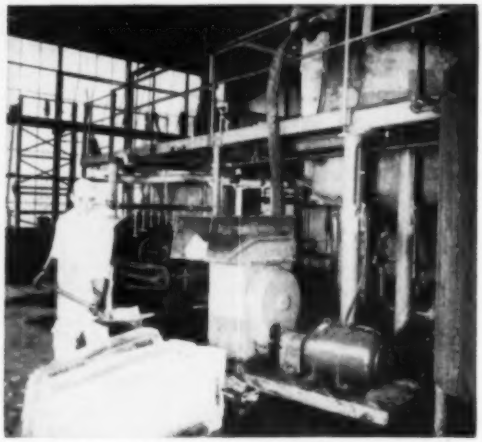
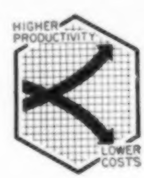


Fig. 2—Portable ice crusher-slinger simplified materials handling and improved crystallization of a chemical product.

Fig. 3—For one-way drum movement along a wharf the platter conveyor does the job at lower cost than industrial trucks.

Fig. 4—Sometimes a platform conveyor is the answer in the handling of miscellaneous loads, but the case is borderline.

Wages Up, Costs Down With Better Materials Handling



Better grade labor today realizes that improved materials handling means savings leading to higher wages

WILBUR G. HUDSON, Consulting Engineer, Chicago, Ill.

We all have noted the increased consideration that is being given today to materials handling. It has been a long pull. Not so long ago plant layout was often developed without thought of materials handling. Then later study of the methods by which the flow through the plant could be maintained efficiently was necessary, and the engineer whose job it was had a tough time. He might be asked to provide for movement of material from building A to building C, only to find that building B was between the two, forcing him to go over, under, or around.

Planning from the start

Today it is not unusual for the plant to be laid out around the material handling scheme. Probably full realization of the importance and possibilities of mechanical handling in cost reduction came when we got into the full swing of wartime production. The volumes and quantities involved were fantastic and speed became paramount. The improvements adopted have had a marked influence on methods subsequently used. One illustration is the today's widespread

employment of motorized industrial trucks, which frequently show savings as high as 90 percent as compared with earlier manual handling methods.

Saving through safety

It is appreciated that if mechanized handling will enable a given capital investment to increase output volume, then both fixed charges and profits will improve—but there are other factors. The New York Department of Labor, in Bulletin 181, mentions that 23,735 material handling accidents were compensated in a single year in New York State, at a cost of $5,009,000. "In the whole field of industry," says the report, "there is no place where safety and efficiency are so intimately associated. The same effort which makes the handling of goods less costly also makes it safer."

Another factor is the growing realization by labor, unless misguided by short-sighted or subversive leadership, that improved methods pay off. The young man of average intelligence and a normal degree of ambition appreciates that educational opportunities can lift him from the "common labor" class to the semi-skilled level, commanding twice the pay. Under favorable conditions, he knows, he can go on to the skilled labor level with unlimited possibilities. The need for common labor in a country like ours tends to decrease relatively, while the demand for men with specialized skills increases.

Gadgets speed production

Along with education and training comes a better appreciation of devices or methods which increase output with decreased effort. This fact impressed a group of British industrial leaders here on a recent tour of American plants. One commented, "People in the United States are so gadget minded they won't work long at a job without trying to rig up a gadget to speed up the job or do part of it for them. That is why the American worker produces more than most British plant workers, without exerting any more effort."

Notwithstanding an appreciation of what mechanical handling can accomplish in cost reduction executives must, of course, be shown how long it will take for the installation to pay for itself. Only then can an expenditure of thousands of dollars be approved. This is not always easy to demonstrate. Naturally, the conveyor manufacturer cannot be expected to guarantee savings—for one reason, he has no control after his equipment is installed.

Cuts both ways

I recall one offer to install the equipment covered by a rejected bid without charge, and maintain it for ten years. The consideration was a 50-50 split of the savings in handling costs. Such a proposition has possibilities both ways, though somewhat risky for the contractor. The manufacturer of motorized trucks has an advantage here. He will send one of his machines and lend a trained operator to prove, through actual demonstration, the results that can reasonably be expected. The reaction of the men is uniformly helpful. That gadget-mindedness on which the Englishman commented does seem to exist. Perhaps it is just a sense of pride inspired by a smoothly functioning plant in those working there.

Not infrequently there are circumstances where improvements in mechanical handling not only reduce operating costs but substantially improve the functioning of the processing equipment. During the war considerable difficulty was encountered in making metallic magnesium from flake magnesium chloride. This fragile material must be fed continuously to a battery of electrolytic cells. The operation calls for a horizontal runaround conveyor, operating continuously. If the magnesium chloride is ground up, the cells will not function and must be shut down and cleaned out. This happened frequently when the material was pushed by a scraper conveyor, causing much lost time.

A runaround carrier was devised which handled the material with practically no degradation and eliminated shut-down of the equipment. This machine (Fig. 1) consists of a train of rectangular buckets attached to a roller chain on the inner side, with automatically operated drop-bottom gates. Surplus material remains in the buckets and is re-circulated until a new discharge point is crossed.

Handling fragile spheres

Subsequently this carrier has found a place in the chemical industry. For example, Fig. 1 shows a West Coast installation for handling fragile pellets, or thin-shelled spheres, weighing about 10 lb. per cu. ft. The material is delivered to a line of storage bins, and must be handled without degradation. Known as the "Side-Kar Carrier," it has worked out nicely. The installation has a rectangular path 70 ft. long by 12 ft. between runs, and is driven by a 1 hp. motor at 16 ft. per min., handling up to 700 cfh.

Slinger does it better

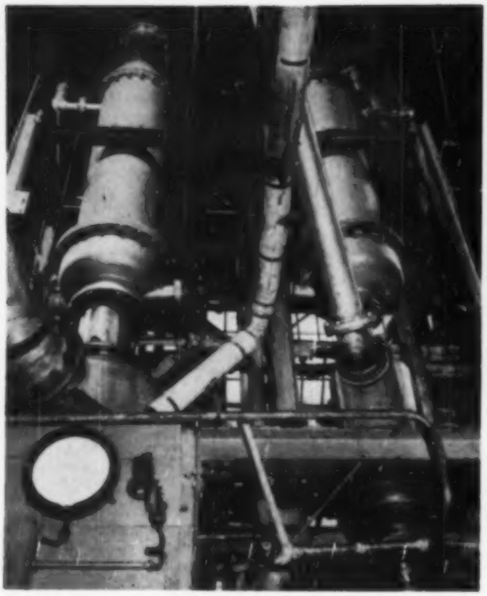
A clever handling re-arrangement which substantially improved the product at small investment cost occurred in a Chicago chemical plant. Originally ice cakes were hoisted to a charging platform where an operator broke them up and shovelled these rather large chunks into a tank. Here a solution was agitated and chilled for crystallation. The relatively small total surface area of the ice chunks not only caused undesirably large crystals, but brought about the occlusion of solvent in the crystals. Six cakes of ice—about 2,400 lb.—were used per charge. The solution entered the vessel at about 100 deg. C. Obviously if the ice could be used in finely ground condition, the efficiency of the operation could be improved.

A simple ice-slinger was installed. This device pulverizes and sprays snow-ice into the tank. The greater surface area of the finely crushed ice provides not only much quicker cooling but gives control of the crystal size. Being conveniently portable, the ice crusher-slinger unit can be pushed from one vessel to another as required, as Fig. 2 suggests.

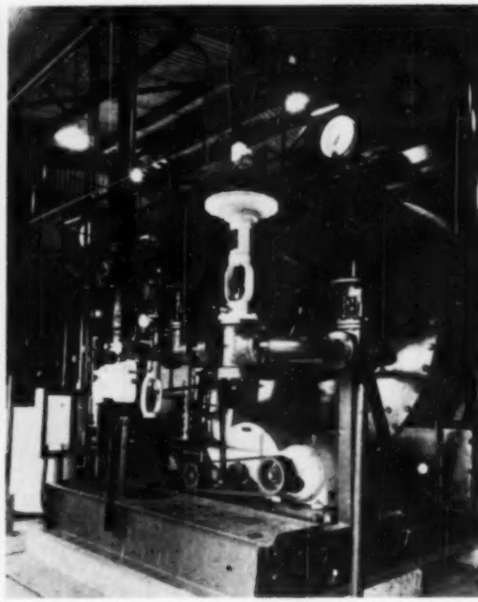
Truck versus conveyor

Returning to the motorized industrial truck and its applications, its use is now generally accepted for handling packaged or palletized loads from cars, through the plant, to storage, and to cars for shipment. However, since the efficiency of its performance and the maintenance costs and damage to buildings, sprinkler pipes, merchandise, etc., are all dependent directly on the skill of the available personnel, this device has by no means rendered the conveyor obsolete. A conveyor may offer the better solution of a given problem.

(*Continued on page* 106)



Heat exchangers are typical of equipment cleaned by acidizing, with greatly improved heat transfer.



Boiler scale is often removed efficiently with acid and proper additives. Gas fire boilers are pictured.

Acidizing Cuts Cost of Cleaning Process Equipment

HIGHER PRODUCTIVITY — LOWER COSTS

Here in a two-part article is information on the actual savings from acidizing, and on cleaning techniques

ROGER WILLIAMS, Jr., Assistant Editor, Chemical Engineering

Cutting maintenance costs by cleaning equipment with acid is not new. *Chemical Engineering* first discussed it in 1927 (July, p. 423). Companies have been actively doing such work since 1932. But relatively little has been written about the economics of acidizing.

Acid's early use

The early use of hydrochloric acid, inhibited to prevent attack on steel, was in acidizing oil and gas wells. Where productive zones were located in limestone formations, injection of acid into the well would increase the size of the bottom hole. Since oil and gas production rates depend on area, the greater the hole size the greater the production.

As the use of acidizing grew, the companies doing the work naturally looked for other uses for inhibited acids. A ready market appeared to be cleaning boilers, removing the residual solids left in boiler tubes by the evaporating water. Many a chemical company has been using this method.

The big place that acidizing fits into chemical processing is in cleaning piping systems, heat exchangers, towers and other equipment that gets "gunked up" every so often. Here, acid dissolves the "gunk" without having to dismantle the equipment. Chemical cleaning is not only cheaper, but it also means a shorter shut-down time. That can mean two things: lower maintenance costs and the possibility that spare equipment may not be needed.

Easily accomplished

The way acidizing is handled is pretty simple. Most companies doing such work have trucks that bring the acid to your plant. More than that, they have pumps mounted on their trucks. All they need are suitable piping connections to get the acid into the unit, a supply of steam and water, and, of course, a sewer. Acidizing operators usually haul in concentrated, inhibited hydrochloric acid. They dilute it as they put it into the equipment and heat it at the same time.

In most cases, chemical companies employ acidizing companies to do the work. Such companies have the trucks, the know-how, and do a good and inexpensive job. A few of the larger companies do their own work.

The figures in the accompanying table were supplied to this magazine by a major chemical company with the request that the company

Acid vs. Mechanical Cleaning

Equipment	Method	Shut-down Time Req'd	Approx. Cost
Heat Exchangers (2), each with 225 steel tubes 1 in. O.D. × 20 ft. long	Acid Mechanical	24 hr. 4-14 days	\$350 \$800-2,000
Condenser of York absorption refrigeration unit	Acid Mechanical	8 hr. 48 hr. minimum	\$275 \$400-1,000
4 × 40 ft. gas scrubber with metal rings	Acid Mechanical	None 12 hr. minimum	\$450 \$750 minimum
Shell and tube cooler	Acid Mechanical	24 hr. 48 hr.	\$375 \$1,275

remain anonymous. In support of chemical cleaning, the figures speak for themselves.

Acid is better

On the types of equipment tabulated, acid cleaning has proved definitely superior to cleaning by mechanical means. The quality of the cleaning is better, outage time and cleaning costs are greatly reduced, some equipment can be cleaned without removing it from service, and some equipment can be effectively cleaned which cannot be cleaned satisfactorily any other way.

The heat exchangers mentioned in the table are used to transfer heat from a process gas to water passing through the tubes. The heated water is then used along with steam at 450 psi. to humidify a process gas. The amount of 450 psi. steam required is inversely proportional to the heat transfer in the exchangers.

Big steam saving

The effectiveness of one cleaning of the water side of the exchangers by acid washing is shown by a reduction in the consumption of 450 psi. steam from an average of 81 lb. per M cu. ft. of gas to 61 lb. per M cu. ft.

Acid cleaning the water side of the condenser increased the production of the unit from 280 tons of refrigeration per day to 350 tons per day.

The scrubber is used for scrubbing traces of ammonia from CO gas at slightly above atmospheric pressure. Cleaning by acid washing is done with no interruption of production. Gas pressure drop was reduced in one instance from 56 in. to 12 in. of water and ammonia carryover eliminated entirely.

The cooler has ammonia at 45 psi. on the shell side and is used to cool scrubbing water at 450 psi. passing through the tubes. The heat transfer coefficient was increased by acid cleaning of the water side from 60 to 170 Btu./(sq. ft.) (hr.) (deg. F.).

Refinery cleans its boilers

A large oil refinery has found acid cleaning of their boilers to be cheaper than turbining them. It required 1,700 man-hr. at \$1.50 per hr. to turbine a boiler, whereas acid cleaning cost only \$1,400. Acid cleaning increased steam production of a boiler in another plant from 598 lb. of steam per M cu. ft. of gas to 629 lb.

Elsewhere, gasoline stock ran 20 deg. cooler through the 15 condensers cleaned with acid than it had been when mechanical methods were used. Based on vapor losses at the 20 deg. higher temperature, the chemical cleaning job would take only 12½ days to pay for itself.

8 hr. vs. 8 days

Two water filters, back-wash distribution system, and 8 in. feed line were chemically cleaned in 8 hr. at a total cost of \$750. No dismanteling of equipment and no disturbing of sand or gravel beds was necessary. Usual mechanical cleaning took 8 days for removal and replacement of sand and gravel beds while no method was available for cleaning the backwash system. The cost of materials involved in the mechanical method far exceeded the cost of chemical cleaning. No cost estimate was made for downtime.

In another plant two absorption towers and their preheaters were cleaned by first treating with a hot 5 percent alkaline solution and then with a 7 percent acid solvent. After the acid treatment, the equipment was washed and a final 1 percent alkaline wash given it. Total cost of cleaning was \$800 and downtime came to only 10 hr. as compared with \$1,200 and 4 days downtime for mechanical cleaning. From operational data chemical cleaning proved far superior.

LEO A. STOUFFER, General Manager, Vandergrift Industrial Acidizing Co, Charleston, W. Va.

Chemical cleaning of many deposits in process equipment is meeting with continuously wider acceptance in the chemical industry because of lower costs and greater convenience as contrasted with mechanical cleaning.

What equipment?

Equipment often cleaned by chemical methods includes heat exchangers, condensers, scrubbers, absorption towers, stills, heaters, boilers, engines, compressor jackets, tanks, and pipes. Deposits encountered, which can be successfully removed by chemical methods, include scale or coatings consisting of carbonates, phosphates, oxides, sulphides, sulphates, silicates, or organic matter.

A sample of the deposit is taken and analyzed in order to determine the proper solvent. In over 90 percent of the applications where chemical cleaning has proved practical, the basic chemical solvent is HCl.

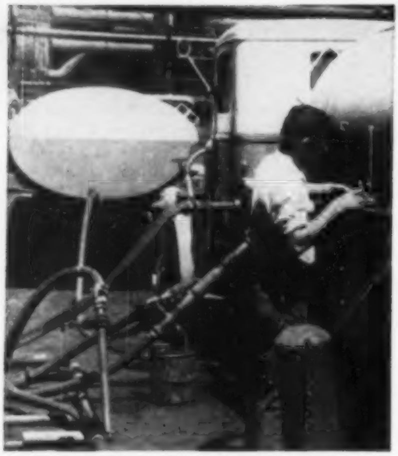
To this are added wetting agents for penetration of dense or oily deposits, and inhibitors which prevent appreciable attack on the surrounding metal. Intensifying agents such as fluorides are sometimes included when silicates are present.

Where sulphates are in the deposit, a 5 percent alkaline solution is first boiled in the equipment. Silicate scales have also been successfully removed in this manner. Sulphides require absorption in caustic of the hydrogen sulphide formed to eliminate the toxic hazard.

Solvents used for deposits containing organic matter are generally of an organic or alkaline nature. Emulsions of an alkali, kerosene or other solvent, and an emulsifying agent are sometimes used. Many cases are known where special oxidizing agents have proved successful in removing stubborn organic deposits.

What variables?

The variables in chemical cleaning are the strength of solution, the retention time, and the temperature. The HCl solutions used are generally between 5 and 10 percent, although solutions up to 15 percent have been used to clean badly corroded pipelines and solutions as low as 2 percent are not uncommon. The



Such truck tanks are used for acid cleaning. Here the operator is checking acid strength.

retention time depends on the solubility and thickness of the deposit. The temperature depends upon the solubility of the deposit and the effectiveness of the inhibitors at elevated temperatures. Inhibitors now in use are generally considered good for a maximum of 120 deg. F. with cast iron and up to 160 deg. F. with bronze, brass, steel, and Monel. Conservative practice dictates the use of temperatures below these maximums. HCl cannot be successfully inhibited for use in cleaning aluminum, zinc, or other light metal equipment.

Time is short

Chemical cleaning is accomplished by soaking, circulating, and spray methods. Large pieces of equipment such as boilers, large vertical heat exchangers, and tanks are usually cleaned by soaking. The normal time is 6 to 8 hr.

The circulating method is used whenever agitation is necessary such as in cleaning heat exchangers having very small tubes and engine jackets having parts difficult to vent. The solvent is pumped through the equipment to a sewer, or returned to the tank truck for reheating and strengthening, if necessary. Further agitation can be had by use of steam or compressed air.

Often no shut-down

Quite often it is possible to clean equipment requiring cooling water without shutting down. In most cases it is necessary to run the equipment at less than full capacity, because it is not generally economical to circulate the solvent to the sewer at the same rate as cooling water would be circulated. It is in these cases that a very low concentration of solvent can be used. Equipment which has been kept in operation during cleaning includes engines, gas compressors, and blast furnaces. All types of scrubbers that use water as a scrubbing medium have been cleaned while operating under full load, the acid being used to replace the water.

The spraying method is used to clean open type box condensers.

It is important that in all types of chemical cleaning, proper venting be provided for gases generated.

Experience counts

Although the basic principles of chemical cleaning are simple, the difficulties encountered are sufficient to warrant a thorough study of the chemical and physical characteristics of the deposits encountered and a knowledge of the applicable inhibitors, wetting agents, and intensifiers before attempting a cleaning job. Knowing the strength of solvent to use, the retention time, and the temperature for a specific application comes largely from experience.

Wages Up, Costs Down

(continued from page 103)

Fig. 3 illustrates the job of moving oil drums along a long wharf, to and from barges. The alternatives of a tractor handling trains of three or four trailers, or a reversible conveyor, make a valuable study. At the terminal points the costs will be about the same, but the movement between is handled better and at lower cost by a conveyor. If we assume a three-shift operation and a traffic of 75 drums per hour, we may specify one tractor, one spare, and 12 trailers of five drums capacity each (15 or 20 drums per train trip). This means an investment of about \$10,000. Operation will require three operators at \$10 per day each, and there will be a part-time charge for a maintenance man of \$3, or \$33 per 24-hr. day.

Life offsets cost

The conveyor with 15 hp. motor will cost about \$20,000 erected. Its power and maintenance costs will be substantially lower, and about the only labor cost will be a part-time charge for the maintenance man, say \$3 per day. The investment is larger, but the life of the conveyor with ordinary replacement of worn parts should be at least 15 years.

If we introduce the further requirement that traffic must move in both directions simultaneously, the tractor-trailer method shapes up better.

Fig. 4 illustrates a border-line case. There is a direct movement of miscellaneous freight to floor storage and back. A reversible apron conveyor with a light overhead power hoist may be provided to unload and reload the conveyor. Traffic is intermittent and in such a case a truck might function elsewhere when not needed for freight movement. That factor could well be the deciding point in favor of the truck.

Find the best way

This discussion of course has by no means exhausted the matter of cost reductions that are possible from improvements in the movement of process materials. Nor has it tried to detail the various alternatives that the materials handling engineer is sure to face in each particular case. The idea that should be left, however, is that there are alternatives and that there is usually a best way from which the greatest savings and the maximum satisfaction on the part of the personnel can be attained.

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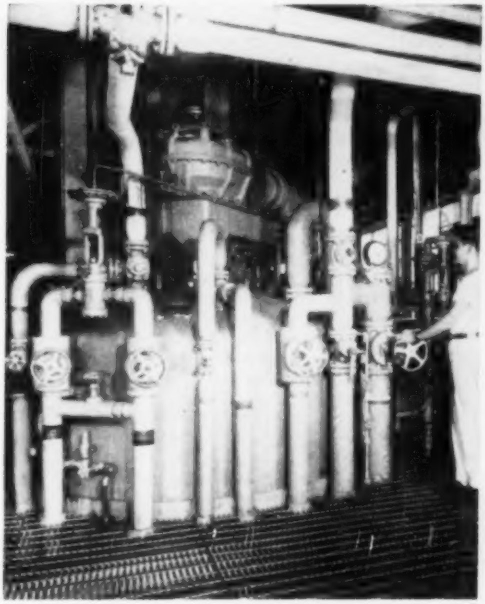
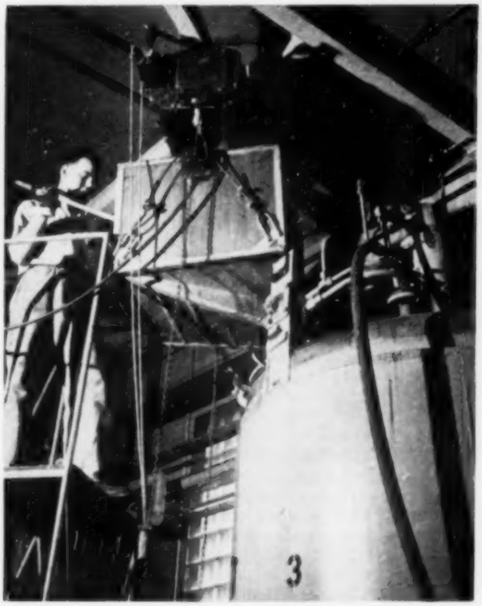


BIOLOGICAL PROCESS is typified by this 5,000-gal. Inconel-clad fermenter where mold growth makes Chloromycetin.



SYNTHETIC PROCESS uses conventional plant equipment such as this kettle for acetylation and hydroxymethylation.

CHLOROMYCETIN BY PARKE, DAVIS

Parke, Davis has created an unprecedented situation in developing both a biological and a synthetic process for producing an antibiotic. Both are operating in the same plant

THEODORE R. OLIVE

Ever since the recognition of the value of penicillin some ten years ago, laboratories throughout the world have been actively pursuing the possibilities for synthesizing various of the presently known and proven antibiotics. Theoretically, at least, synthesis should have many advantages over biological methods because fermentation processes are tricky and easily contaminated. But the antibiotics as a class are extremely complex compounds and none of the many attempts led to a practical commercial result until Parke, Davis & Co., at Detroit, developed a successful synthesis of Chloromycetin, its new antibiotic, during 1948.

The story of Chloromycetin is a long one in terms of achievement, if not in time. In space of only about two years the compound has been isolated, proved, synthesized, and put into production by both fermentation and synthetic processes. We now have the unusual situation of witnessing a friendly contest between a biological and a synthetic process for the same material, operating in the same plant (although in different buildings) and producing a product which is identical in its properties, regardless of the method of manufacture. For the first time an opportunity is afforded to test whether the theoretical advantages of synthesizing an antibiotic are as great in fact as they appear to be on paper.

THEODORE R. OLIVE is associate editor of Chemical Engineering.

Before we go into the competing processes, we must look briefly at the antibiotics as a group, and particularly at the background and accomplishments of Chloromycetin. For, even though research may be able to untangle nature's antibiotic principles, at present it lacks sufficient information on the relations of structure and effect to discover antibiotics certainly without nature's help.

BACK TO THE SOIL

In the last two decades, since the classical work of Fleming in the late 1920's, it has become increasingly evident that the chemical byproducts of some of the lowly fungi have remarkable curative properties. Nearly every cubic inch of surface earth harbors tremendous numbers of organisms, including those resulting in the present known antibiotic chemicals, and doubtless many unknown ones as well. Hence it is not surprising that biologists and mycologists have been turning to the earth in their search for substances antagonistic to disease germs. Since the soil has presumably reached a state of equilibrium with respect to the many different kinds of organisms it contains, in all likelihood the earth itself is the most fertile source for the discovery of bacteria-antagonistic principles.

Several antibiotic substances have been isolated and studied within recent years, but the only ones known to be of commercial importance prior to November 1947 were penicillin and streptomycin. The third member of the trilogy, Chloromycetin, had already shown encouraging results in animal experimentation, but it was not until Dr. Eugene H. Payne of Parke, Davis reached Bolivia late in 1947 that the full possibilities of this new antibiotic became evident. Having with him the world's entire supply—less than one-half pound—Dr. Payne gambled it all against a severe epidemic of typhus fever which was raging in the little Bolivian town of Puerto Acosta. The supply lasted only for the treatment of 22 patients. All made recoveries within a few days, and yet 28 percent died among the 50 untreated cases studied in the area.

The second test came in March 1948 when a team of Army medical workers took off with another pound of Chloromycetin for Kuala Lumpur, in Malaya. Here a closely related killer, scrub typhus, was playing havoc with the population, yet 100 percent recoveries was achieved in the 25 cases treated. Included among the patients were several with unrecognized typhoid, rather than scrub typhus, and they too recovered, but in a somewhat longer time. Thus, it was discovered that the new antibiotic is effective also against this disease, for which an effective treatment had never before been available.

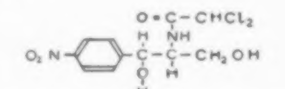
Another confirmation in still another field was obtained in the summer of 1948 in Baltimore where 17 patients suffering from Rocky Mountain spotted fever were freed of their fever in two days instead of the usual 17. Again, a disease which generally kills more than 20 percent of its victims was conquered with 100 percent effectiveness.

Chloromycetin was thus proven to be a weapon against a variety of organisms resistant to other known drugs and antibiotics. It is effective in cases of intestinal infections, notably typhoid fever; bacillary infections of the urogenital tract; and the fevers in which rickettsiae are causative. The latter are minute disease-causing parasites, intermediate between viruses and bacteria. Typhus, scrub typhus, and Rocky Mountain spotted fever are typical of the rickettsial diseases. In addition, Chloromycetin shows possibilities against undulant fever, primary atypical pneumonia, psittacosis, Q fever, lymphogranuloma venereum, several of the bacillary dysenteries, whooping cough, and possibly also against cholera and bubonic plague.

HOW IT STARTED

Chloromycetin's history started with a research grant made by Parke, Davis to Yale University. Dr. Paul R. Burkholder, in charge of the work, collected some 6,000 samples of soil from every corner of the earth and began the tedious task of isolating micro-organisms from the samples. In so doing he found more than 20,000 different molds, but of these only a limited number showed activity worthy of further investigation. At the Parke, Davis research laboratories, Dr. John Ehrlich and his associates further studied the cultures and devised methods of growing them in quantity. Of all these, the culture later identified as Chloromycetin proved most promising for further effort.

The company assembled a team which was given the responsibility of determining the best method of growing the mold, of translating laboratory methods of isolation of the product into plant scale methods, and of studying the potentialities of the material. In a remarkably short time the major problems had been worked out, the chemical structure had been determined, and a decision had been made not only to produce it biologically, but to attempt its synthesis. Chemically the compound *D*-(−)-threo-1-*p*-nitrophenyl-2-dichloroacetamido-1,3-propanediol (or chloramphenicol for short), Chloromycetin has the structure:



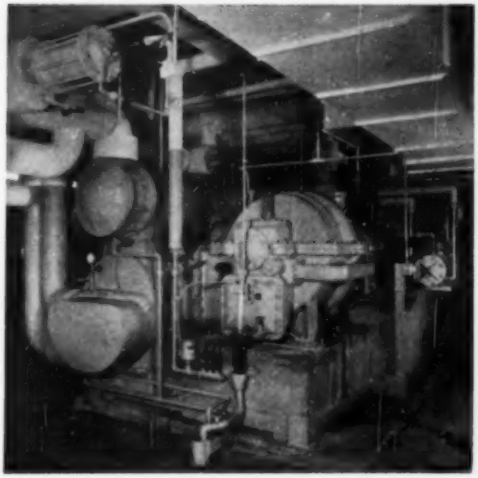
This compound not only has the property of being effective against an important class of diseases, but it is unique in being the first known product produced by a micro-organism that contains either a nitro group or a dichloracetic acid group. Although fairly complex, its structure suggested the possibility of synthesis, and a research chemical team went to work developing, first, one synthetic process, and then a second process as well. Pilot plant crews took over and evolved a successful commercial application of one of the processes, for which a full-scale plant is just now being completed.

Biological Process for Chloromycetin

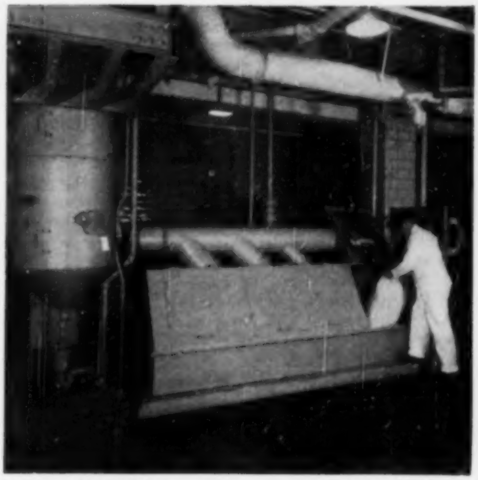
PICTURED FLOWSHEET PAGE 172

AN INTERESTING and outstanding feature of the H. K. Ferguson-built plant in which Chloromycetin is produced biologically is the fact of its great versatility. Work on the plant, designed for producing streptomycin, was started in 1945, with the idea that it should be capable with slight modification of producing penicillin or any other antibiotic which might later be desired. Late in 1948, when the plant was completed, the decision was made to use it for Chloromycetin rather than streptomycin. However, with slight change, it can be converted to either penicillin or streptomycin, virtually without adding any additional equipment, simply by a minimum of repiping of existing equipment. In fact, not all the equipment which was installed initially for producing streptomycin is necessary in making Chloromycetin. The latter process is considerably simpler.

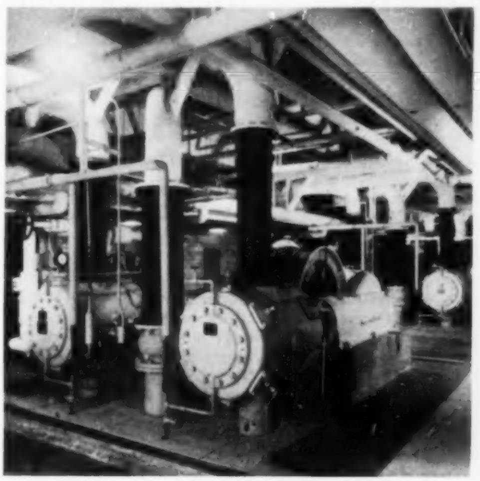
The plant occupies a ground space of 350 x 100 ft. and is partly two-story,



CHILLED WATER is provided to a closed cooling system at 48 deg. F. by two Carrier centrifugal water vapor units.



SOLID MATERIALS enter the process by being slurried with de-ionized water in this group of hooded hopper mixers.



AIR SUPPLY for mold growth is compressed to 35-40 psig. in these four Ingersoll-Rand duplex carbon-ring compressors.

FERMENTATION batches of the mold are aerated, agitated and cooled for 76 hr. in seven 5,000 gal. fermenters.

partly three-story, and partly four-story in height. Materials are received on a spur track and unloaded to a ground-floor receiving and preparation department where raw materials are stored and nutrient solutions and filter-aid slurries are prepared. All such storage and preparation take place in this department, which is isolated from the rest of the building to avoid any dust problem. The raw materials include the ingredients for the nutrient medium, which consists of wheat gluten, glycerine, sodium carbonate, and sodium chloride. Other raw materials include diatomaceous filter aids, activated carbon, a penicillin-type defoamer, sulphuric acid, caustic soda and sodium bicarbonate for pH adjustment, and amyl acetate for extraction of the broth.

The other principal raw materials are water and air. The plant uses both city water and river water. The latter is used for cooling a closed chilled water system, with or without auxiliary refrigeration, depending on the season of the year. When the river water is not cold enough, the closed chilled water cooling system employs two Carrier centrifugal water-vapor refrigeration units. For process use city water is put through de-ionization units, and the de-ionized water is stored in aluminum tanks. Most of the cooling requirements are satisfied with 48-deg. F. water from the Carrier units. However, the plant employs some ammonia refrigeration, in which case the heat

transfer medium is a glycol-water brine. In addition, the laboratory employs distilled water for its own experimental purposes.

Air for the plant air-conditioning system, and also the intake air for the fermentation system, is cleaned by American Air Filter Airmat electrostatic filters. Air for the aerobic growth in the fermenters then goes to four Ingersoll-Rand carbon-ring reciprocating compressors, each a duplex machine with an after-cooler, carried on separate foundations to isolate vibration from the building. The air at 35 to 40 psig. flows to a group of steel receivers, then passes through stainless steel mesh and carbon sterilizing filters before entering the spargers of the fermenting tanks. The plant air-conditioning system serves offices, laboratories, and some manufacturing departments.

The process may be considered as starting in the biological laboratory where cultures of the desired mold, *Streptomyces venezuelae*, one of the *actinomyces* family, are preserved and grown. The initial culture is kept in a dormant state in earth under refrigeration. From time to time agar "slants" in test tubes are seeded with the parent culture and grown under carefully controlled sterile conditions. To serve this function, as well as the numerous research and control activities conducted in the building, a special nutrient room is provided where culture media are prepared, as well as a special "kitchen" where all laboratory glassware is sterilized, then cleaned in a dish-washing machine and resterilized.

After the "slants" have reached the optimum stage of development, the culture is scraped out with a silver wire loop and is maintained in a dormant condition under refrigeration until needed, suspended in a castile soap solution. The soap solution suspensions are preserved in this department until called for by the manufacturing department.

IN THE PLANT

The plant process proper may be considered to start with the preparation of the nutrient medium. (For a Pictured Flowsheet, see p. 172.) The medium solids are weighed in the desired proportions into a 1,500-gal. aluminum preparation tank provided with an agitator. Here the nutrient is made up in concentrated form with de-ionized water, after which it is pumped as needed to a single 5,000-gal. tank in the fermentation room which serves as the sterilizing tank for the seven seed tanks and seven fermenters. To follow through any particular batch, we start with the pre-seed room in which there are seven 50-gal. Inconel tanks, each provided with a jacket for steam or chilled water, and an air sparger. A tank is charged with nutrient medium which is diluted to needed strength with de-ionized water, then sterilized at 252 deg. F. with steam on the jacket. Chilled water at 48 deg. F. then circulates through the jacket to cool the contents from sterilization temperature. Now the tank is ready for inoculation, which is accomplished in a sterile and ingenious manner. The culture medium grown in the biological department is brought to the pre-seed room in a sterilized syringe and is injected into the tank through a self-sealing rubber diaphragm by penetrating the diaphragm with the syringe needle. The culture grows under sterile air agitation and close temperature control at about 86 deg. F. Cooling water is supplied to the jacket under automatic control to maintain this temperature by withdrawing the heat of growth. A back-pressure valve maintains air pressure at about 10 psig. to prevent possible in-leakage and contamination. The duration of growth in the pre-seed tank is optimum at about 24 hours. Then the contents of the tank is ready to be blown by sterile air into one of the seed tanks in the fermenter room.

The fermenter room contains eight 5,000-gal. vessels of 20 percent Inconel-clad steel, equipped with Inconel four-blade agitators, baffles, and Inconel cooling coils. It also contains seven 500-gal. seed tanks which are of similar construction except for the use of jackets rather than coils. One of the eight 5,000-gal. tanks is used only for sterilizing the freshly prepared nutrient medium. Each batch in this tank consists of enough nutrient to charge one seed tank and one fermenter. Concentrated nutrient solution from the preparation tanks is run in, diluted with hot de-ionized water, and heated with live steam through a ring sparger to a sterilizing temperature of 252 deg. F. Chilled water is then run through the coils until the temperature is reduced to the fermentation temperature of about 82 deg. F. The charge is then transferred by sterile air pressure to one seed tank and also one of the fermenters. Both tanks have previously been manually cleaned and sterilized with live steam at 225 deg. F.

As soon as fermentation of one of the pre-seed charges has been completed, the tank contents is blown to one of the seed tanks already freshly charged with sterile medium. Cooling water is put on the seed tank jacket, the agitator is started, and the air bubbled through the sparger to raise the internal pressure, under control of a back-pressure vent valve, to about 10 psig. The temperature at the seed tanks is maintained at about 82 deg. F. for the entire period of growth of about 24 hours, which represents the optimum time for this operation.

When a seed tank charge has been propagated to the optimum point, it is blown with sterile air to one of the 5,000-gal. fermenters which has been freshly charged with sterile nutrient medium. Here, again, fermentation proceeds for an optimum period, which in this case is about 76 hours. Again, this requires cooling water on the coils, temperature control at about 82 deg. F., and continual flow of sterile air, together with mechanical agitation. When fermentation is completed the contents of the fermenter is discharged by air pressure to 3,000-gal. Inconel-lined tanks which serve as feed tanks for the filters. Here filter aid and decolorizing materials are added.

Before going on to describe the filtration, it is well to discuss a number of features of the fermentation operation. One of the tanks in the preparation room is used to store a defoaming oil which is maintained hot, at sterilization temperature, and is circulated continuously by a pump through a loop line connected through automatic equipment to each of the fermenters. Each fermenter is provided with electrodes which detect the formation of foam. As soon as the foam level begins to rise, the anti-foam agent is automatically injected from the circulating line until the foam subsides.

As in the case of so much of the equipment, most of the process valving and piping in the plant is Inconel. In lines where contamination might take place, notably those associated with the pre-seed, seed and fermentation tanks, steam connections are provided so that steam flow can be maintained through all lines of this character when they are not otherwise in use. These same three steps in the fermentation process are all carefully instrumented with temperature and pressure controllers on each tank. In addition, the 5,000-gal. fermenters are provided with continuous pH recorders. Broth is continuously withdrawn from each fermenter by an Oliver diaphragm pump, circulated to a Leeds & Northrup pH electrode, and returned to the fermenter.

FILTRATION OPERATIONS

Each finished batch of broth from the fermenters must be filtered to separate the mycelia and produce a clear, polished broth containing the Chloromycetin. For this purpose two Oliver pressure-type rotary precoat filters are used. The filters are precoated with

a diatomaceous filter aid suspended in de-ionized water. Precoating is accomplished by a new automatic system. A thick slurry of filter aid is made up in the preparation room and pumped to one of two 100-gal. precoat tanks. The concentrated slurry is then mixed with de-ionized water, using a ratio flow controller employing venturis as the metering elements. The precoat filtrate (2) and precoat overflow from the filter tank, (3) in the flowsheet, p. 172, are dropped to the other of the two precoat tanks. A small amount of filter aid and decolorizing agent is added directly to the broth in the 3,000-gal. filter feed tanks and then the broth is pumped into the pressure filter (4). The cloudy filtrate (5) produced initially is returned to the feed tanks (8), as is the filter tank contents (7) at the end of a run. The clear filtrate (6) flows to two 3,000-gal. holding tanks of 3S aluminum.

The two pressure filters are fabricated of Inconel and 20 percent Inconel-clad parts, and each has 50 sq.ft. of filtering surface on a drum 5 ft. 3 in. in diameter by 3 ft. wide. Each filter handles one batch, at the rate of 1,000 gph., employing a pressure of 20 psig. At the end of a filtering run, the remaining broth in the tank is drained and returned to the feed tanks, the cake is washed with de-ionized water, and then the cake is scraped from the drum and delivered by a screw to an inclosed Inconel-clad cake receiver. The contents of the receivers, consisting of spent filter aid and mycelia, is discarded.

COUNTERCURRENT EXTRACTION

Broth accumulated in the aluminum holding tanks can then be given a further polishing in an available 31-in. plate-and-frame filter press, although this has not proved necessary. The next step, therefore, is to pump the broth to the Podbielniak centrifugal countercurrent extractor, where the Chloromycetin is extracted in amyl acetate.

Contrary to practice in the penicillin industry, where three stages of countercurrent extraction are commonly employed, only one stage is needed in the Chloromycetin process. It is also unnecessary to alter the pH sharply and the extraction problem is considerably simplified because Chloromycetin is much more stable than penicillin.

The Podbielniak extractor, developed by Dr. Walter J. Podbielniak of Chicago, is a machine which maintains contact between counter-flowing phases of two immiscible liquids, at the same time separating the phases by centrifugal force. It consists essentially of a drum containing a spiral of 33 turns of stainless steel strip, supported at the sides to form a closed spiral passage 160 ft. long. The drum is mounted on hollow trunnions for rotation at any suitable speed up to about 2,500 rpm.

Seals at either end of the trunnions enable a heavier liquid to be introduced through suitable passages to the outer end of the spiral, being withdrawn at the center, while a lighter, immiscible liquid is introduced at the center and withdrawn at the outer end of the spiral. The liquid content of the rotor, introduced by pump pressure, is about 7 gal., and the throughput time only a few seconds. Control of the back pressure of the lighter liquid controls the relative volumes of the two liquids present in the rotor at any time.

As the liquids flow in opposite directions through the spiral, the heavier one seeks the outside, and the lighter the inside of the passage. At intervals mixing is accomplished by perforations through the wall of the spiral which permit some of the heavier phase to bubble through the lighter, after which centrifugal force produces separation. Depending on the application, it is claimed that one extractor may give the equivalent of five theoretical extraction stages or better.

In extracting Chloromycetin, the extractor is operated at 2,500 rpm. The broth is the heavy liquid, the amyl acetate the light. Both are introduced by pumps provided with bypass valves. Manual control is used, with flow rates adjusted from the visual indication of a rotameter in each feed line. A single Chloromycetin batch, including the wash water used on the filters, amounts to about 5,000 gal. For this purpose the extraction requires about 900 gal. of amyl acetate, so that approximately a 5 to 1 concentration is accomplished. Contrary to practice in extracting penicillin, it is unnecessary to use demulsifying and wetting agents in this step. The throughput rate for the extractor is about 360 gph. combined liquids, and the total time required for a single batch of broth, about 14 hr. At this rate, with a single extractor, it is possible to handle a maximum of about 10 batches per six-day week. With seven fermenters, this means a total active time of about 108 hr. per week per fermenter, which allows ample down time for cleaning.

The Chloromycetin-acetate concentrate from the extractor is collected in a 1,500-gal. tank of Type 316 stainless steel and then is concentrated further, to about 40 gal., in an Inconel natural-circulation evaporator operated under a 0.3-in. vacuum produced by a three-stage ejector. Operating temperature is less than 100 deg. F. This Buflovak evaporator is the type employing an external calandria and a separate flash chamber. The acetate collected in the stainless steel condenser is further cooled, decanted, and filtered through a Dollinger filter from which it is returned to two 1,000-gal. storage tanks for subsequent reuse.

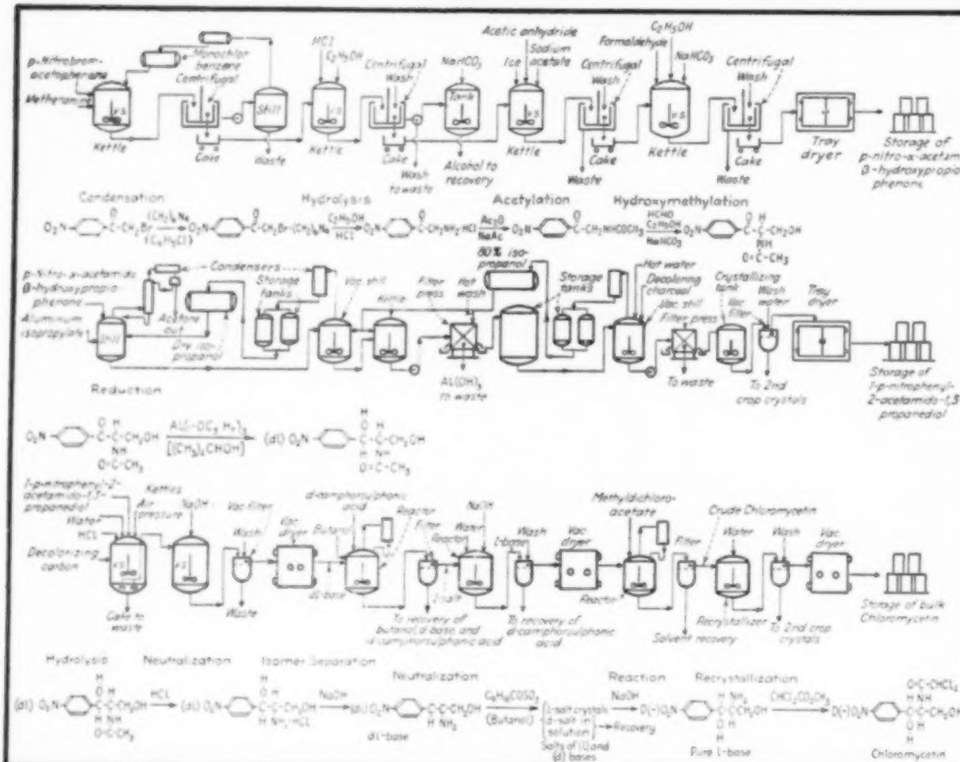
PURIFYING AND CRYSTALLIZING

The concentrate from the vacuum evaporator, consisting of Chloromycetin dissolved in approximately 40 gal. of amyl acetate, is withdrawn from the evaporator at the end of the run to a small portable, wheeled vessel and transported to a 100-gal. tank equipped with a portable agitator. Here the concentrate is washed with acid, alkali and water. It is first agitated with one-tenth its volume of 0.01 N sulphuric acid, then settled and separated. It is then extracted with an equal volume of 5 percent sodium bicarbonate solution, and again settled and separated. It is finally agitated with an equal volume of de-ionized water and again settled and separated. In each case the extracts are collected and returned to the aluminum feed tanks for the Podbielniak extractor. The washed amyl acetate extract, still comprising about 40 gal. is then charged into a small glass vacuum crystallizer where the remaining amyl acetate is vaporized and condensed at 100 deg. F., and the residue, containing the crude Chloromycetin crystals, is reduced to a volume of about 2 gal.

The crude crystal containers are carried to a refrigerated room where they are held for 8 hr. at 40 deg. F. to complete the crystallization. The material is then manually filtered on a stoneware suction filter and the partially purified crystals are charged in trays into a vacuum dryer for removal of the remaining solvent.

From the dryer six batches of crystals are combined and charged to a 200-gal. recrystallizer, provided with low-pressure steam on the jacket. The crystals are slurried with about 70 gal. of water and mixed with one-tenth their weight of decolorizing carbon. Upon heating to 200 deg. F., they go into solution in the water. Chloromycetin is very sparingly soluble in water at room temperature, a fact which is the basis of the recrystallizing step. Furthermore, in distinction to penicillin, a Chloromycetin solution can be boiled for a fairly extended period without deterioration. The slurry of decolorizing carbon and Chloromycetin solution is then dropped hot from the solution vessel to a 12-in. Shriver plate-and-frame filter press which has been preheated. The clari-

fied solution is further polished in a heated Selas ceramic filter and the hot concentrate then flows to an open 75-gal. crystallizing tank equipped with a jacket. Here the crystallization is completed at about 40 deg. F., using chilled water on the jacket. The purified crystals are then filtered out on a stoneware suction filter and washed with de-ionized water, the water and mother liquor being returned to the extractor feed tanks. The finally purified crystals are then removed manually from the filter to an atmospheric tray dryer from which they are transferred to a Micro Pulverizer for final reduction prior to screening, packaging, and shipment.



Synthetic Process for Chloromycetin

Although the synthetic process is a relatively complex one, involving ten reactions and a total of about 30 steps (not including various recovery operations), it has a number of obvious advantages compared to the biological process. For one thing, it requires much less operating space for a comparable output, and it is free from the contamination problems inherent in any fermentation process. Also, much smaller quantities of materials are in process at a time. However, only study over an extended period will permit a full economic comparison of the two processes, and thus show whether one or perhaps both will be the survivor.

The chemistry of the process has been described in detail by Long and Troutman, in a paper in the July 1949 issue of the *Journal* of the American Chemical Society. However, it will be desirable to sketch over the reactions hastily. The starting raw material is *p*-nitrobromacetophenone, which is available on the market and so need not be synthesized in the plant. This material is first condensed with hexamethylenetetramine (methenamine), then hydrolized with ethyl alcohol and muriatic acid, and acetylated with acetic anhydride and sodium acetate. The resulting product is subjected to hydroxymethylation with formaldehyde and sodium bicarbonate, the product reduced with aluminum isoproplyate, then hydrolized with muriatic acid. Following neutralization with caustic soda, the isomer mixture resulting is separated by reaction with d-camphorsulphonic acid, the desired isomer recovered by neutralization with caustic soda, and the resulting product reacted with methyldichloracetate to yield Chloromycetin. These ten reactions are indicated, together with the associated equipment, in the accompanying flowsheet. The process logically divides itself into eight major steps, of which the first four, being similar in the unit operations employed, are grouped together. The fifth reaction and its associated steps form a separate group, as do the last three.

The process is conducted on a batch basis, most of the equipment being of standard character. In several cases, the same equipment is used for two or more operations.

In general, vacuum for the various stills is produced by three sets of two-

stage, non-condensing steam jet ejectors. Vacuum for the several vacuum dryers is obtained from a three-stage steam jet equipped with intercondensers. General vacuum, required for filtration, partial evacuation of receivers, and other miscellaneous uses, is supplied by a Nash vacuum pump. All kettles and stills are jacketed and provided with 40-psig. steam, as well as chilled water for cooling purposes. Ejectors all operate on 80-psig. steam.

The first four reactions, shown in the top line of the flowsheet, involve the use of three 1,000-gal. kettles, all provided with variable-speed drives on the agitators. This group of operations also employs a 500-gal. still for recovering monochlorobenzene, a 40-in. bottom-discharge centrifugal, a 1,000-gal. tank for neutralizing alcohol before recovery, and atmospheric dryers.

In this series of operations, the raw material, *p*-nitrobromacetophenone, is condensed in one of the 1,000-gal. kettles with hexamethylenetetramine in the presence of monochlorobenzene. The reaction mass is brought up to temperature and dropped to the 40-in. centrifugal for recovery of the crystals of condensation product. Since the crystals are very fine, the removal of liquor is difficult. The liquor is pumped to the 500-gal. copper still for recovery of the monochlorobenzene, while the condensation product is carried to to a 1,000-gal. tank for the hydrolysis reaction.

The crystals are now mixed with ethyl alcohol and muriatic acid under agitation and raised again to reaction temperature. The mixture is cooled, separated from the alcohol in the centrifugal, and washed with water. The acid alcohol mixture flows to a 1,000-gal. storage tank where it is neutralized prior to alcohol recovery, using soda ash. The cake removed from the centrifugal is charged into a 1,000-gal. kettle and agitated with acetic anhydride. Sodium acetate is then added and the mixture stirred until acetylation is complete. Crystals of the acetylated product are cooled, recovered in the same centrifugal, washed and transported to the hydroxymethylation step. The separated liquors are discarded.

For the next reaction the crystals are charged to a 1,000-gal. kettle, together with formaldehyde, ethyl alcohol, and sodium bicarbonate solution. Under agitation the mixture warms sufficiently from heat of reaction. It is held until the reaction is complete, after which it is cooled, separated in the same centrifugal, washed with water, and the crystals of *p*-nitro-α-acetamido-β-hydroxypropiophenone are dried in an atmospheric tray dryer. The liquors are discarded.

The fifth step, which consists in the reduction of the dried ketone from step (4) and its purification to produce *dl*-threo-1-p-nitrophenyl-2-acetamido-1,3-propanediol, involves a succession of reactions (with separation of acetone), recovery of isopropanol, separation of aluminum hydroxide, evaporation, charcoal treatment, crystallization, filtration and drying. If needed to secure the necessary purity, one or more recrystallizations may be employed. The mother liquors are worked up for a second crop of crystals. This sequence of operations requires a 500-gal. still, with a packed fractionating column; a second 500-gal. vacuum still, with an agitator; a 300-gal. kettle; a filter press; several storage tanks; two 36-in. diameter stoneware suction filters; and atmospheric dryers.

The ketone from step (4) is charged into the 500-gal. fractionating still for reduction with aluminum isopropylate in the presence of anhydrous isopropanol. During the distillation the isopropanol refluxes and the acetone produced is separated. The mixture is then pumped to the vacuum still for the recovery of dry isopropanol for reuse. Water and 80 percent isopropanol are added to the hot residue, which is agitated, heated and refluxed for a time. The aluminum hydroxide produced is removed in the filter press and washed with 80 percent isopropanol, after which the press cake is discarded.

The filtrate and washings are accumulated in a 1,000-gal. tank, then evaporated to dryness in the vacuum still for recovery of the isopropanol. The residue in the still is dissolved in hot water, agitated with decolorizing charcoal, and pumped through the filter press to a holding tank where the solution is cooled to crystallize the product. The crystals are separated in the suction filters, washed with water and dried. Should the purity not be up to standard, recrystallization may be resorted to, either before or after drying.

At this point, it should be explained that the product of the fifth reaction is mixture of four isomers. Two of the four isomers produced in the reduction step are eliminated in the purification and water crystallization of this product, leaving the other two to be separated. Therefore, it is necessary—after hydrolysis and neutralization of the step (5) product—to react with a compound which will carry the unwanted isomer into solution, but permit recrystallization of the desired levo product. The separating compound is recovered by neutralization of the dissolved *l*-salt crystals and the resulting *l*-base is reacted with methyldichloroacetate to yield the crude Chloromycetin which is recrystallized and dried as finished product.

For the last group of steps the equipment includes two 1,000-gal. kettles, both equipped with variable-speed agitators; two 500-gal. reactor-stills with reflux condensers and agitators; two 36-in. stoneware vacuum filters (which are to be replaced with a 48-in. centrifugal); and two vacuum dryers. The *dl*-threo-1-p-nitrophenyl-2-acetamido-1,3-propanediol from step (5) is first hydrolized in one of the 1,000-gal. kettles, by use of muriatic acid. Decolorizing carbon is then added, the kettle contents agitated, and the solution is filtered. The carbon cake is flushed off to waste while the solution is cooled in the 1,000-gal. kettle, then neutralized with sodium hydroxide. The resulting *dl* base is then separated from the waste liquor on one of the stoneware filters, washed and dried in a vacuum dryer. The dry product is now dissolved in butanol in one of the 500-gal. stills, and reacted with *d*-camphorsulphonic acid which takes the unwanted isomer into solution. On cooling, the desired *l*-salt crystallizes out and is separated on a stoneware filter. The filtrate is worked up for recovery of the butanol, *d*-base and *d*-camphorsulphonic acid, while the *l*-salt crystals are dissolved in water, then decomposed by addition of sodium hydroxide. The solid *l*-base is separated by filtration and washed, while the filtrate is saved for recovery of *d*-camphorsulphonic acid. After the *l*-base crystals have been dried in one of the vacuum dryers, they are charged into one of the 500-gal. stills, methyldichloracetate is added, and the mixture heated to complete reaction to crude Chloromycetin. After cooling the crude crystals are filtered on a stoneware filter and then are recrystallized from water by heating, followed by cooling. The resulting crystals are filtered off, the mother liquors saved for a second crystal crop, and the purified material is vacuum dried as final product.

In concluding this account of pioneering work, we wish to acknowledge the enthusiastic support and assistance of several members of the Parke, Davis staff, particularly Harvey M. Merker, superintendent of manufacturing, W. H. Mohrhoff, superintendent of the antibiotic division, E. F. Lau, manager of antibiotic manufacturing, and also Messrs. Ralph Hummel, Russell Van House and W. F. Roser, chemical engineers associated with the synthetic development.

1. Know your product's properties.
2. Know where, how and why it is used.
3. Convey your knowledge to present and prospective customers.
4. Study competing products.
5. Try to adapt your product to lucrative non-using industries.
6. If you lack facilities, use independent or customers' laboratories if necessary.
7. Organize interest in specifications and methods of test for your products so the public can get them from ASTM, ASA, governmental groups, and trade associations.
8. Streamline your handling of customer relations.
9. Keep your products abreast or ahead of competing items.
10. Remember customers are buying more than the product; they are buying the job the item will do, and a piece of the total effort that went into development of your product.

Ten Steps to Higher Sales

Plenty of attention is needed to keep markets for old-line chemicals growing

W. J. RILEY

Maintenance and expansion of known and new uses of old or established chemicals are relatively more important than the commercial developments of new chemicals. In fact, this importance grows as each new chemical matures and graduates to old chemical status—a regular production and sales item.

Consideration of old chemicals may prove helpful in solving some of the problems associated with new chemical development. With old chemicals the primary agencies are production, sales, consumer (established and potential) and competitor. On new chemicals these agencies are primarily research, sales development, potential customer, and potential competitor. Also, in contrast with new chemicals, it is certainly easier for the manufacturer of an old chemical to justify expenditures for additional plant capacity, applications research or process improvement since he knows production costs, that prices are reasonably firm, and that known or potential markets are well established or easily estimated. For example, it is a matter of simple arithmetic to determine that a reduction in cost of 0.1c. per lb. of an old chemical produced at the rate of 100 ton per day can mean a savings in round numbers of $70,000 per year—less taxes of course. Similarly a 10 percent increment in 100 tons per day production, assuming a labor and overhead cost of $200 per day which is unaffected by this production rate, the savings can approach $7,000 per year. The potential consumer, on the other hand, secure in his sources of supply and with these factors well established can more easily justify his application and process research. Fortunately, for our over-all economy and welfare, the competitor can also evaluate his potential stake and act accordingly. Perhaps the higher degrees of certainties are another reason for the lack of published consideration of old chemicals. Perhaps the job was considered done, of insufficient importance or too routine to warrant detailed consideration. Yet it must be remembered that new chemicals owe their birthright to the availability and earnings of old chemicals and the techniques that were developed in marketing them.

In an attempt to evaluate some of the factors relating to and the methods in use by chemical companies for maintaining and developing markets for old chemicals a letter was sent to 49 members of CCDA and CMRA asking how their particular organization handled certain phases of the problem. Responses by mail and by personal contact were gratifying and indicate considerable interest in this problem. Twenty-eight replies contained sufficient information to be of value.

W. J. Riley is manager of Technical Sales Division, Westvaco Chemical Division, Food Machinery & Chemical Corp. He presented this paper at the Commercial Chemical Development Association meeting at Niagara Falls, on June 24, 1949.

THE PROBLEMS INVOLVED

The problems are extremely complex, no two organizations do things exactly alike; some organizations are relatively simple and involve few people, others are large, in fact are groups of what might be considered large separate companies and involve many people. In some instances sales are handled by exclusive sales agents, such as Enjay Co., a subsidiary of Esso Standard Oil Co., and General Dyestuff Corp., selling agents for General Aniline and Film Corp. The products vary in number and nature—organic, inorganic, naturally occurring and synthetic, liquids, solids. They vary tremendously in end uses, some being confined predominately to a single use and others have almost universal use. The organizations promoting and supporting sales vary from very small ones, to complex organizations with different functions handled by large groups.

Yet despite these complexities and variances there is a fairly high degree of fundamental similarity. The fundamental functions are carried out in all instances and the major differences lie

in the degree to which functions become specialized or departmentalized. This is largely a question of size and stage of evolution.

In the earlier days, when the industry started and when companies were small, sales and production were frequently handled by the same individual and there was little or no service. The need for chemical control became apparent and works laboratories were set up and simple customer problems were usually turned over to these laboratories.

GROWTH OF SPECIALIZATION

Additional products were made. As the problem of production and the consumer grew, groups in the works laboratories became more specialized, evolving eventually into control, process development, research and applications expanded and became more highly technical. Competitive forces developed to higher degrees. The need for assisting customers in using products in many instances resulted in the development of highly specialized sales service and market research groups. All of us are in various stages of these developments and in analyzing our daily problems are looking for the most effective and economical methods of organizing our efforts to give speedy and accurate answers to our employers, associates, and our customers. We are trying to improve on many of these evolutionary changes which were in many instances too haphazard and insufficiently coordinated to meet today's challenge.

In most chemical companies individual salesmen are assigned specific geographical territories to cover. In many organizations they sell the complete company line. Their efforts are coordinated locally by a district sales manager who, in turn, reports for coordination purposes to the home office, usually to a product sales manager responsible for a specific group of chemicals generally related by chemical composition. These product sales managers report through sales executives to management.

The following chemicals are sold primarily on this product basis: acids, alkalis, acetone, alcohols, ethers, phosphates, peroxide, furfural, sodium silicate, halogens, sodium sulphate, soda ash, borax, cyanides, sulphides, and chlorinated solvents. Of course, some of these may be sold also on a strictly industry basis and the dividing line is not sharp. Products fall into this group by virtue of basic chemical properties or widespread utility of some simple physical property such as solvency pow...

On the basis of information supplied by respondents, the sales of 13 organizations shown below fall in this product classification. In a number of instances, however, specialization either on a product group or industry basis becomes necessary at the district level.

Sales Based on Products

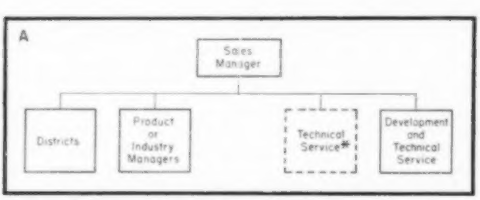
Anonymous 1
Anonymous 2
American Potash and Chemical Corp.
Celanese Corp. of America
Diamond Alkali Co.
Electrochemicals Department, E. I. du Pont de Nemours & Co.
Hercules Powder Co.
Hooker Electrochemical Co.
International Minerals & Chemical Corp.
Jefferson Chemical Co., Inc.
Mallinckrodt Chemical Works
Monsanto Chemical Co.
Quaker Oats Co.
Shell Chemical Corp.

Actually, an applications or even a unit process classification is more expressive in some specialized lines—for example, the sale of solvents for extraction of activated carbons for adsorption, and of oxygen, acetylene, welding and cutting equipment, and supplies.

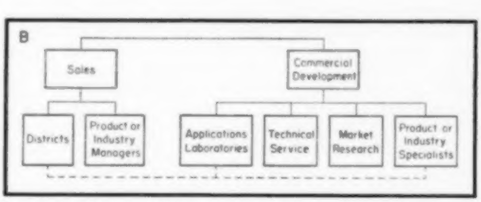
Again, in a non-inclusive illustration, the following industry classifications may be cited: pharmaceuticals, agricultural chemicals, livestock feeds, baking chemicals, plastic molding powders, lube oil adhesives, dyes, fertilizers, laundry and dry cleaning, dairy detergents and disinfectants, refractories, inks, paints and varnishes, explosives, fire extinguisher fluids, ad-

Here Is How 17 Chemical Companies Handle Expansion of Markets for Old Chemicals

Company	Organization Type (See charts)	Technical Service	Old Product Development	Responsible For Maintaining Sales	Responsible For Expanding Sales
Anonymous-1	B	Yes	Yes		
Anonymous-2	B	....	Yes	Product Manager	Commercial Development & Product Manager
Anonymous-3	A	Yes*	Yes	Product Manager	Product & Sales Promotion Managers
Celanese Corp. of America	A	Yes*	Yes	Sales Manager & Technical Service	Sales Manager & Development
Commercial Solvents Corp	A	Yes	...	Sales Department	
Dow Chemical Co	A	Yes	Yes	Sales Division	Development & Technical Service
Enjay Co	B	Yes	...	President & Vice President	President & Vice President
General Dyestuff Corp	B	Yes	Yes	Sales	Sales & Commercial Development
Hercules Powder Co	B	Yes	Yes	Technical Service & a Staff Unit	Technical Service & a Staff Unit
Hooker Electrochemical Co	A	Yes	Yes	Development	Development
Jefferson Chemical Co	A	Yes	Yes	Sales Manager	Sales Manager
Monsanto Chemical Co	A	Yes	Yes	General Manager	General Manager
Chas Pfizer & Co., Inc	A	Yes	Yes	Development	Development
Shell Chemical Co	A	Yes	Yes	Sales Vice President & Sales Manager	Sales Vice President & Sales Manager
Spencer Chemical Co	A	Yes	Yes	Product Manager	Product Manager
Victor Chemical Works	A	Yes	Yes	Sales Department	Sales Department
Westvaco Chemical Division	A	Yes	Yes	Product Manager	Product Manager



Most used sales organization has a sales manager on top.



A sales-development liaison system is also widely used.

Sales Responsibility Varies With Different Firms

	Responsibility for Maintaining Sales	Responsibility for Developing Sales
Entire organization	1	1
President	3	3
Vice president sales	2	2
Sales manager	2	2
Product sales manager	6	3
Sales department (as a whole)	11	7
Commercial development (may be part of sales)	(2)	8 (4)
Technical service	..	1
Staff organizations	..	2
Totals	27	29

sorbent carbons, and carbon blacks. In general, products fall into this classification by virtue of specific physical, chemical, physiological or bacteriological property, or combinations of these. As extremes in this classification we find highly technical fields as well as those industries which are primarily arts.

In 11 organizations shown below sales, including the central organization in some instances, are handled both on a product and industry basis. In two instances sales were broken down on an industry basis.

Sales Based on Product and Industry

Anonymous (3)
Commercial Solvents Corp.
The Dow Chemical Co.
Enjay Co.
Mathieson Chemical Corp.
Pennsylvania Salt Mfg. Co.
Chas. Pfizer & Co., Inc.
Sharples Chemicals, Inc.
Shawinigan Chemicals Ltd.
Spencer Chemical Co.
Westvaco Chemical Division

Let us now consider some of the functions required to support the sales effort. Just how are the problems of maintaining sales and developing new sales handled? First considering sales for established uses and starting again with the individual territorial salesman, it was found in many instances that the uses of his products were simple, well established, and his experience sufficiently broad so that he could personally handle the usual service problem and sales prospect. In rare instances he needed some additional help and called upon someone either from production or research, who had more technical experience with the product, for assistance. Only in one such instance did an organization report that this was the case for all its products. In several instances, however, some parts of the field forces function on this basis. With proper technical training or experience this is a highly effective and economical method of solving many of the problems encountered.

As we proceed up the evolutionary scale we find various stages of development and refinement. In 23 instances central technical service functions were found to report directly to some part of the sales organization in 18 cases. In five instances technical service functions are either part of research or a sales development group occupying about the same level in the organization chart as sales.

In four cases the central technical service functions were duplicated in the sales districts with organization on the product basis.

Looking at the picture a little more closely and considering sales as consisting of a vice president, sales manager, and product managers, we find the breakdown as shown in the accompanying table.

A simplified organization chart has been prepared and an attempt made to classify individual companies where sufficient information was available, in order to give a more detailed picture of the manner in which they handle service, expansion of markets for new uses of old chemicals, and to indicate where responsibility for these functions lies. Again, it must be remembered that no organization is as simple as indicated. Considerable liberties have been taken in the organization charts of some individual companies in order to fit them into the simplified pattern.

The pattern into which the largest number of organizations fit is shown in Chart A.

The next most common type of organization is shown in Chart B where technical service and old product development are divorced from sales and are handled by a commercial chemical development group. In three reported instances, these functions are divorced from sales and are a part of the technical department. In two instances these functions are under the direct control of the product sales manager.

The effectiveness of the product manager in carrying out his functions is determined in a large measure by the support he receives from his own staff and the staffs of supplementing groups.

With minor exceptions, existing service organizations indicated that their personnel was technically trained. One specific exception was noted, however, and that is in the sales and servicing of fertilizers—men with experience in the field are preferred.

All of these complex factors—type of sales organization, the positions of service and development groups in an organization in relation to research, sales, and production, and the degree of responsibility of each in continuing the development of old chemicals and particularly the relationship of this responsibility and degree of direct control over laboratory facilities can only be resolved in the ultimate analysis by the individual company.

Liaison functioning of service groups has been the result of the need of correlating activities that have been superimposed on existing facilities. However, the question naturally arises as to whether this is the most effective way of meeting today's problems. Consideration of the basic factors associated with these problems can develop a more thorough understanding of the principles to be followed by individual companies.

SALES PROMOTION TOOLS

Chemical advertising literature, such as catalogues, brochures, bulletins, leaflets, and data sheets, is one of the tools employed in promoting sales. There is considerable variation in extent and type of information given on old chemicals even by a single organization, to say nothing of the industry as a whole. In this survey an attempt was made to explore existing attitudes and policies regarding the subject. About 96 percent of the respondents were in favor of using this tool and thought it was necessary. This was the only area in which there was a high degree of agreement.

There appears to be fairly general agreement that chemical and physical properties, known and suggested uses, shipping containers, and, depending upon the type of literature and product, detailed use instructions should be included.

The controversial area appears to the extent and form in which specifications and analytical data are given. In some instances only assay is given; in others, specifications showing minimum assay and certain maximum impurities are given. In others, analyses are given. The job is sometimes made tough for the purchaser by not defining the terms or giving loose definitions, such as average or typical. These points can frequently be important and may govern his choice of supplier. Hesitancy in publishing or supplying complete analytical data is due to the adverse effects it might have on production as the result of special requests by customers. Although each case must

be considered individually, it would certainly seem possible for the industry to do a better and more consistent job.

DEVELOPMENTAL INFLUENCES

The people who cooperated in this study were also requested to give an expression of their experience on the relative influences of external (customer demand) and internal (applications research) factors on the development of old chemicals. There were some interesting replies to this question. By a ratio of 4 to 1, experience indicated the influence of external factors to be the major one. In several instances experience indicated that the balance was about even. Two companies expressed diametrically opposite viewpoints on policy regarding this matter. One indicated that efforts were primarily directed toward acquainting potential consumers with the chemistry of his product so that everything possible was done to stimulate external interest. In the other instance the idea was expressed that the manufacturer should carry the ball on uses and applications of his product. However, strictly chemical and less specialized use applications developments on old chemicals result primarily outside the manufacturer's organization, as also is the case usually with new chemicals.

Despite conflicting statements, consideration of some of the factors lying behind them indicates that each may be right in this patricular case. For example, the nearer the product application lies to the consuming public the greater the responsibility assumed by the manufacturer in developing new uses. To be specific, it is hardly likely that uses such as nematode control with ethylene dibromide (an old chemical) discussed by D. K. Ballman of Dow Chemical at CCDA's March 1948 meeting or repelling insects with an old plasticizer, dimethyl phthalate, could be developed without the availability of highly specialized applications laboratories and highly efficient and closely coordinated technical effort that was required to bring these developments into commercial application.

On the other hand, very little application work is required by the manufacturer of such basic chemicals as sulphuric acid, chlorine, or phenol. These chemicals and their applications are well known and this knowledge is part of the basic technical background of every chemist and chemical engineer. The continued growth of such chemicals is usually looked upon as the application of the known rather than a new development when they are used in making a new compound. The manufacturers of such basic chemicals are more likely to follow the development of new chemicals in which their own basic chemicals are used, than they are to develop new chemicals in which they have no fundamental raw material position. Dow's internal use of the chlorine they produce is an excellent illustration of this principle.

There are other internal factors which should be considered. One of the major contributions made to any chemical development is price reduction. This usually results from economies resulting in process improvement, increases in production capacity, or a deliberate move with a view of capturing a new market or, perhaps, a greater portion of an existing market. Competitive pressure of new products for the same use as the old product is also a reason for reducing price.

Another factor contributing to expansion of markets, which lies under the direct control of the manufacturer, is chemical quality improvement. Customers do not buy a material on which they must perform purification steps before they can use it, or if they do, it doesn't last very long. Neither will they tolerate impurities that reduce their yields, interfere in processing steps, or effect the quality of their final product in any way. These situations result in special demands on the producer and present major difficulties to him, since he has achieved his position by mass production of a given quality at a stated price. If the customer is a large and important one, entire production capacities may be swung over to the new and improved specifications. If the customer is not quite so large, material from run of the mill production which meets the requirements is selected. In some instances the effect of minor impurities may be so important to the consumer that he is willing to pay a premium and, if the manufacturer is successful in meeting the customer's demand, a new grade of an old product becomes available. Hooker's sodium sulphide is an example of this. Long range the culminative effect of such demands is an improvement in quality to everyone and at a lower price.

Price reductions and major quality improvements are spasmodic in nature, usually the culmination of long research programs on fundamental quality and process improvement. However, daily control over the variables effecting quality and costs is vigilantly maintained. Process control groups are constantly at work to develop maximum efficiencies, to eliminate bottlenecks, and to improve quality.

The problem of disposing of coproducts (or byproducts) which increase in direct proportion to the production of the main product is also a strong motivating internal factor. Such problems can account for expensive and long range research projects, such as the studies under way for the utilization of HCl produced by hydrocarbon chlorination. The increasing demand for chlorine and the economic necessity of disposing of the electrolytic coproduct, caustic soda, led Columbia Alkali to the development of their ammonia extraction process for reducing the salt content of the caustic. Reduction in salt content from 1 percent to between 0.10-0.15 percent and the chlorate content from 0.10 percent to 2-5 ppm. made a product comparable to lime-soda caustic and opened the rayon market to electrolytic caustic for the first time.

CONSUMER-PRODUCER COOPERATION

The dovetailing of consumer-producer interests is also a major factor in the growth of old chemicals. Most manufacturers have little difficulty in handling production increases when a large potential customer comes forward with a concrete proposal to purchase several thousand tons per year of one of the manufacturer's basic products. Whether or not the manufacturer accepts the proposal is usually a policy decision based upon relative position in the overall market, availability of capital, and relative profit returns on the capital in view of other developments under consideration. It is not uncommon to find capital being supplied jointly with the formation of new companies or wholly owned subsidiaries, by organizations respectively wanting and having certain raw materials available.

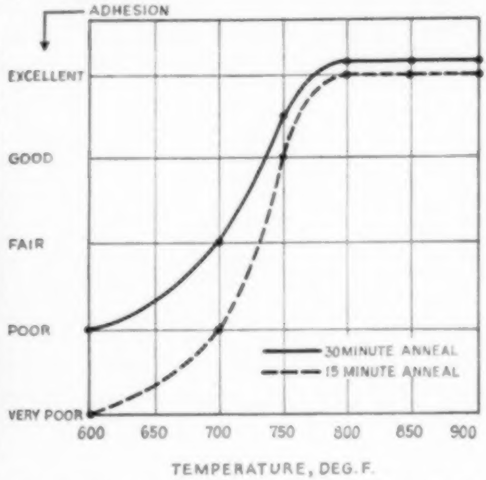
While improvement in chemical quality has been mentioned as a means of increasing uses, modification of physical forms and properties to improve the economic utility of the product and the process in which it is used, is another fundamental approach.

The ways and means of continuing the development on an even higher plane are limited only by boundaries of our imaginative ability to apply our technical knowledge in logical and scientific fashion. Continued cooperative effort will push these boundaries further into the unknown.

Acknowledgement: Sincere appreciation is extended to those organizations which cooperated in providing the data which made this paper possible.

Experimental equipment eliminates an early difficulty . . . .

Laboratory apparatus set-up used in gas plating experimentation for determination of optimum plating conditions.



Blistering was an early problem solved by annealing. Graph shows effect on adhesion of annealing temperature and time.

Metal Plating from Carbonyl Gases

Compared with electroplating, gas plating is faster, gives better reproduction of irregular surfaces, and is applicable to non-conductors such as wood and glass

Gas plating by decomposition of metallic carbonyls is not a new process. But Commonwealth Engineering Co., Dayton, Ohio, whose engineers supplied data for this digest, is finding new applications.

Ludwig Mond started the ball rolling in England in 1890 when he chanced upon the first gas plating phenomenon while studying the effects of finely divided nickel on carbon monoxide. The same commercial process which he later developed and which now bares his name is still used in Europe today for the production of metallic nickel.

Using variations of the same principle Commonwealth has developed and patented a process for nickel plating objects of various sizes, shapes, and materials. To date the process has only been operated on experimental equipment. Continuous commercial units are now in the engineering stages.

ADVANTAGES

While not looked upon at present as a likely replacement for all electroplating, gas plating is expected to find extensive use for specific applications to which it readily lends itself. Materials which cannot be handled by wet electrochemical methods but which can stand the required 400 deg. F. will be gas plated. Among others this includes ceramics, tiles, glass, and wood.

Probably the biggest single advantage of the new process is increased rate of deposition. On a recent test 13 lb. 6 oz. of nickel were deposited on a small table top during a 60-min. plating cycle. Another plating which took 30 min. by the conventional process was deposited in 4 sec. by Commonwealth.

The excellent reproduction of irregular surfaces, internal areas, and complicated structures achieved by the Commonwealth process indicates a bright future for it. Then too, elimination of complex plating baths, delicate solution balancing, and the problem of applying power to irregular surfaces point to a permanent berth for gas plating in the future. Considered still another important advantage is the ease with which the process can be adapted to continuous operation as, for example, in the manufacture of coated sheets rolls or the integrated production of laminates

THE PROCESS

In equation form, the story is very simple. Nickel carbonyl is formed in two steps:

$$Ni + O_2 \rightarrow NiO_2$$

and at 113-194 deg. F.

$$NiO_2 + 6CO \rightarrow Ni(CO)_4 + 2CO_2$$

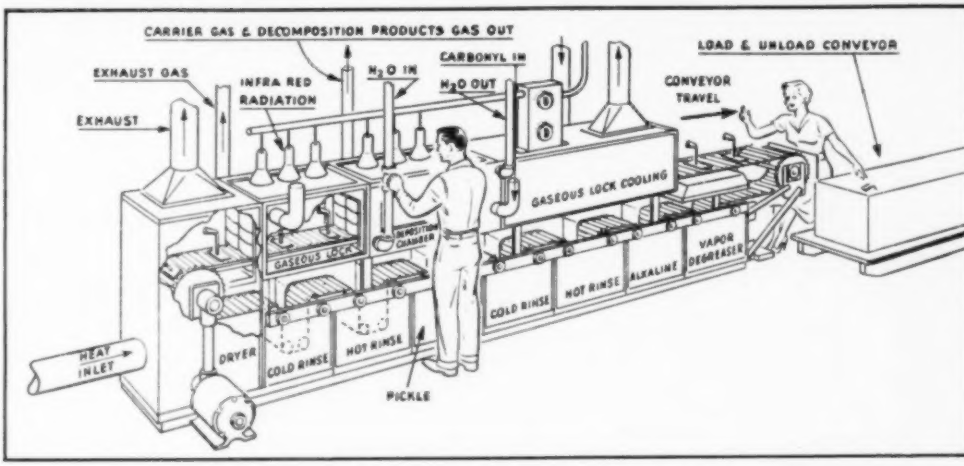
Deposition takes place at 356 deg. F.:

$$Ni(CO)_4 \rightarrow Ni + 4CO$$

In actual practice it is not quite that simple. Materials to be plated are first thoroughly cleaned. This is done by a standard process similar to that for electroplating (as shown in drawing of commercial plating unit) or by a gaseous reducing atmosphere.

Before the process begins the deposition chamber, where plating takes place, is flushed with inert gas to rid it of all traces of oxygen. Gas content is checked with an Orsat gas analyzer. When the oxygen content is nil the piece to be plated is heated to decom-

. . . . points the way to this full-scale production unit of the future



Complete commercial adaptation is the goal of Commonwealth engineers. Here is a sketch of a commercial unit now under construction. Note the manner in which they have adapted the process to continuous operation.

position temperature. This is done by dielectric radiation or conduction, depending upon the size and shape of the object. Heating is probably the most important problem that must be solved for each application to get satisfactory results. Thermal balance must be maintained throughout the decomposition period to insure even plating. It is essential that heat be concentrated in the object being plated during the plating operation. A water jacket keeps the rest of the tank below decomposition temperature.

The plating atmosphere is generated in a hot rolled steel cylindrical carburator. This vessel is first purged with inert gas after which a 5-lb. shot of liquid nickel carbonyl is introduced. Inert "carrier" gas (usually hydrogen) is then bubbled through the 4-in. depth of carbonyl, forming a plating atmosphere of 20 percent $Ni(CO)_4$ and 80 percent carrier gas by volume. This mixture is piped to the deposition chamber where it is sprayed by jet at the object to be plated. To prevent intragaseous decomposition of the carbonyl, the jets are vapor cooled and located close to the target.

To maintain atmospheric pressure when $Ni(CO)_4$ forms Ni and 4CO in the deposition chamber and to overcome exhaust line friction, a centrifugal fan is placed in the exhaust line. The fan blows the gases to a burner where they are burned with natural gas in the atmosphere.

Plating operation completed, the chamber is flushed with dry nitrogen to rid it of $Ni(CO)_4$ vapor, hydrogen, and gaseous products of decomposition. The exhaust gases are analyzed to determine when the deposition chamber may be opened with safety for removal of the part.

DISADVANTAGES

The process has its pitfalls. Both $Ni(CO)_4$ vapors and liberated CO have toxic effects on the human body. For protection of operators provision must be made for gas tight equipment and proper disposal of waste gases by burning.

Nickel carbonyl is a strong reducing agent. Mixed with oxygen it may explode violently at temperatures as low as 60 deg. C. This explains the thorough flushing of both carburator and deposition chamber with inert gases before introduction of $Ni(CO)_4$.

During early experimental stages, difficulty was encountered in the deposition of thick nickel plates due to lack of adhesion and continual blistering. A layer of gas between the nickel plate and the base metal was found to be the cause. The difficulty was eliminated by the following process: (1) Cleaning the base material by abrasion, (2) depositing a thin flash coat of nickel, (3) annealing at 800 deg. F. or above (see graph), and then (4) deposition of the desired thickness of nickel.

TEMPERATURE RANGE

Tests show that decomposition temperatures for maximum efficiency are between 350 and 395 deg. F. Above 400 deg. F. the decomposition of nickel carbonyl is 100 percent complete. However at these higher temperatures finely divided nickel acts as a catalyst to accelerate the dissociation of carbon monoxide into carbon and carbon dioxide. This reaction results in the deposition of a heterogeneous mixture of nickel and carbon. Such mixtures have no commercial value at present. Below 350 deg. F. the decomposition rate of nickel carbonyl rapidly approaches zero.

Deposition of nickel has been tried at both low and high plating atmosphere velocities. Test results indicate that the ductility of the deposited nickel plate varies inversely to the rate of deposition. Further investigations are being made in this field.

OTHER METALS

Nickel carbonyl, a volatile liquid at room temperature and pressure, lends itself readily for carburation with inert carrier gases. This coupled with the metallurgical properties of nickel make it a natural for gas plating. But it is by no means the only metal to which the process applies. Iron, chromium, tungsten and molybdenum have all been applied to base metals by the Commonwealth method. Copper, iron, and lead bases have been prepared and studied extensively in connection with gas plating. And according to Commonwealth this is just the beginning. The goal—complete adaptation for commercial operation.

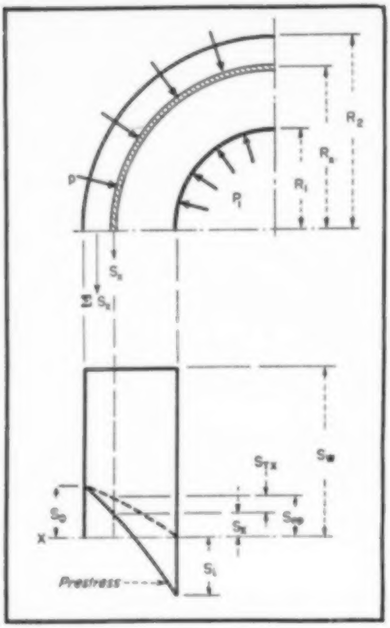


Fig. 1—Typical stress distribution diagram for ideal prestressed vessel construction.

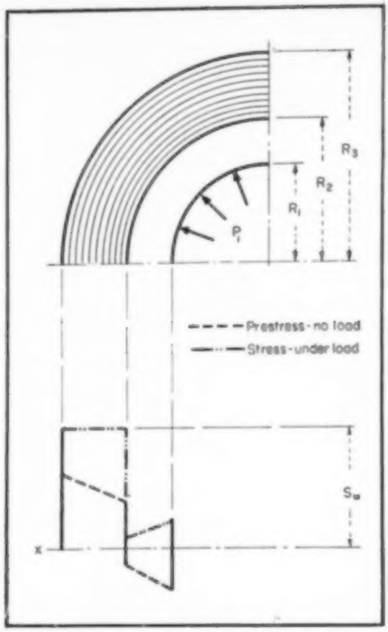


Fig. 2—Typical stress distribution for a ribbon-wound prestressed pressure vessel.

Practical Design of Prestressed Pressure Vessel Shells

This last of three articles on design of vessels for high pressures deals with practical prestressed designs. Earlier articles appeared in August and September

R. R. MACCARY and R. F. FEY

To meet the demand of large scale and economical chemical production today, many new processes must not only operate under unusually high pressures, but also with the continuous flow of large volumes. Such requirements entail the development and design of high-pressure vessels of considerable volume, which means relatively large diameters and heavy shells.

In the first article of this series (*Chem. Eng.*, August 1949, p. 124) the thick-walled, non-prestressed vessel was discussed and design methods considered. However, limitations on the manufacture and the economics of the solid, non-prestressed forged shell have resulted in the investigation and application of other methods of design and construction, employing prestressing. Theory and design of prestressed vessels were considered in the second article (Sep. 1949, p. 105).

These new methods may be divided into two general classifications; first, those using relatively thin plates, sheets or bands to build up a shell of the required strength, with incorporation of varying degrees of prestressing during fabrication; and second, methods of prestressing a solid thick wall.

In the second article of this series it was noted that the ideal use of the material in a thick-wall vessel shell is to develop a uniform tension equal to the allowable working tensile stress of the shell material throughout the entire thickness of the shell wall. Such a condition is produced only under the condition of "ideal prestressing."

It is the intent of this article to present the necessary design criteria for various forms of construction which approach the ideal prestress pattern. An understanding of underlying principles becomes necessary before the vessel designer can conveniently analyze and apply the design equations.

The following discussion is a derivation of the law which must be followed in applying prestressed layers of any form, so that uniform tension

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(i.e., "ideal prestress") will be achieved throughout the layers when the structure is subjected to the design pressure. With reference to Fig. 1 and the second article of this series, the necessary relations may be derived based on the Lamé formulas for stress distribution. Consider the following notations:

Let P_1 = internal design pressure; p = pressure exerted on a layer x by layers applied outside it; R_1 = inside radius of vessel; R_2 = outside radius of vessel; R_x = radius of layer x; S_w = design tensile stress of layer material; S_x = prestress in any layer x under no pressure (refer to the second article), or

$$S_x = S_w - \left[\frac{P_1R_1^2}{R_2^2 - R_1^2}\left(\frac{R_2^2}{R_x^2} + 1\right)\right];$$

S_{xp} = stress of application of layers; S_{cx} = compressive stress imposed on layer x by pressure p; S_{tx} = tensile stress equal to and relieved by S_{cx} during fabrication; ΣS_x = summation of prestress (at no internal pressure) in the layers outside of layer x; and $C = P_1R_1^2/(R_2^2 - R_1^2)$.

The design problem resolves itself in the determination of the composite thickness of shell, either of laminar, ribbon or wire construction, and the stress under which each layer must be applied.

The shell thickness may be determined by applying the ideal prestress formula (from the second article):

$$t = R_2 - R_1 = P_1R_1/S_w \qquad (1)$$

In applying any layer x, a tensile stress S_{tx} equal to the compressive stress S_{cx} imposed by p on layer x must be added to S_x to obtain the tension of application S_{xp}.

The summation of the stresses in the outer layers beyond layer x is

$$\Sigma S_x = \int_{R_x}^{R_2}\left[S_w - \frac{P_1R_1^2}{R_2^2 - R_1^2} \times \left(\frac{R_2^2}{R_x^2} + 1\right)\right]dx$$

$$\Sigma S_x = (S_w - C)(R_2 - R_x) - C[(R_2^2 - R_2R_x)/R_x]$$

The summation of the prestress may be expressed in terms of an externally applied pressure as

$$p = \Sigma S_x/R_x$$

By the Lamé formula, the stress produced by such an external pressure p is,

$$S_{tx} = S_{cx} = p\left(\frac{R_x^2 + R_1^2}{R_x^2 - R_1^2}\right)$$

Therefore

$$S_{tx} = \frac{\Sigma S_x}{R_x}\left(\frac{R_x^2 + R_1^2}{R_x^2 - R_1^2}\right)$$

and by definition:

$$S_{xp} = S_x + S_{tx}$$

$$= S_x + \frac{\Sigma S_x}{R_x}\left(\frac{R_x^2 + R_1^2}{R_x^2 - R_1^2}\right) \qquad (2)$$

This is the stress of application required to develop a prestress pattern throughout the layers so that under design pressure P_1 all layers will be stressed uniformly to the design stress S_w.

FLAT RIBBON WINDING

A method which permits the attainment of prestress construction with unusual control of the prestress pattern is the band or ribbon-winding system, similar to the wire winding employed in reinforcing gun barrels. The principle consists in winding a steel ribbon helically on a core shell, with progressively varying tension in each layer applied, which results in an initial state of stress in the combined coil and core shell.

This method facilitates manufacture in strict accordance with design calculations, by applying a ribbon winding over a heavy-walled core shell which is of sufficient thickness to carry the axial pressure forces. The winding need only carry the circumferential tensile forces. Furthermore, the windings can be applied with predetermined tension in such a manner that each layer will be under uniform tension when the internal pressure is applied. The distribution of stresses throughout the core shell will, of course, follow the Lamé formula. Such a construction possesses inherent advan-

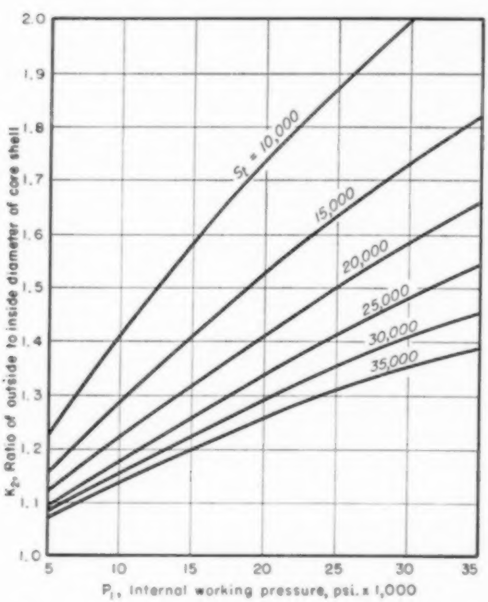

Fig. 3—Design chart for dimensions of core shell based on Eq. (3).

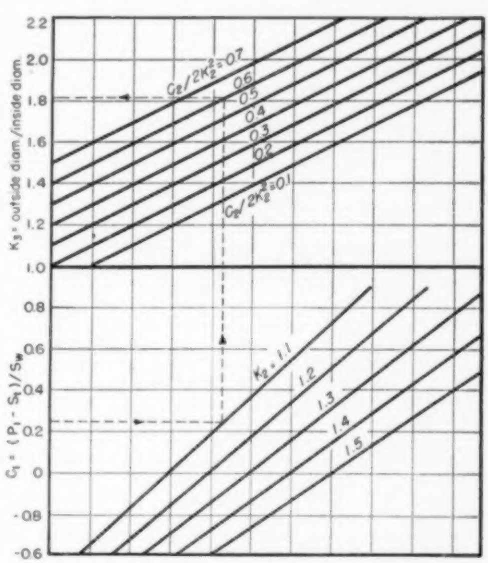

Fig. 4—Design chart for over-all vessel dimensions based on Eq. (4).

tages not found in other designs. The attachment of end closures is considerably simplified, with circumferential welding of the shell seam approaching the minimum required to carry the axial stresses properly.

The principal design calculations involve the determination of the core shell and winding thicknesses, as well as the tension under which each layer of the ribbon must be applied. Such design formulas have been fully developed by Comstock[1] based on the use of materials of the core and windings having equal moduli of elasticity. The dimensions of the ribbon are governed by the maximum tension that can be developed on the winding machine or lathe, and may be readily varied to use commercially available strip steel. The core shell may be either a forging or of pressed plate and welded construction where diameter and thickness permits.

In the design of such a vessel, the values available are the internal diameter, as dictated by volumetric requirements, and the working pressure of the process. After selecting the materials of construction, the allowable working tensile stress of the core shell is determined, as well as the permissible tension in the ribbon under full load. Generally, the allowable tension of the strip steel is considerably higher than the core shell material, which permits a material reduction in weight of the vessel.

Since the applied ribbon winding can carry only tangential stress, the inner core shell must be of sufficient thickness to carry the axial load. With this requirement as a basis of design, the thickness of the inner core may be determined for an economical design.

Referring to Fig. 2, the salient dimensions of the vessel are R_1, the inside radius of the core shell; R_2, the outside radius of the core, and R_3, the outside radius of the winding. Then, considering $K_2 = R_2/R_1$ and $K_3 = R_3/R_1$, the dimensions of the vessel are determined by the formula:

$$K_2^2 = (P_1/S_1) + 1 \qquad (3)$$

where S_1 = allowable tensile stress of the core shell and P_1 = internal design pressure.

To simplify design calculations, the relation of Eq. (3) is presented graphically in Fig. 3.

The value of K_3 must then be calculated from the following equation to establish the diametral dimensions of the winding (or it may be obtained graphically from Fig. 4):

$$K_3 = K_2\,(1 + C_1/2 + C_2/2\;K_2^2) \qquad (4)$$

where $C_1 = (P_1 - S_1)/S_w$; $C_2 = (P_1 + S_1)/S_w$; and S_w = allowable tensile stress in ribbon winding under full loading by internal pressure P_1.

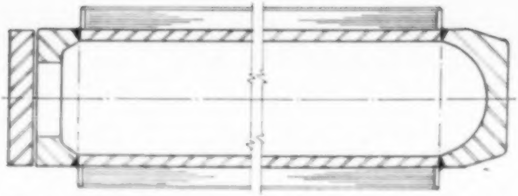

Fig. 5—Typical design for prestressed ribbon-wound or multi-layer pressure vessel.

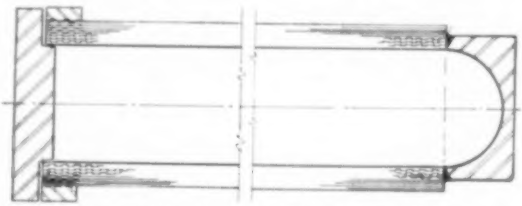

Fig. 6—Typical design for prestressed ribbon-wound vessel with Schierenbeck interlocked ribbon core.

With the dimensions of the vessel established, it is further required to check the maximum compressive stress S_c which the core shell will be subjected to, as a result of the application of the external winding in tension. The compressive stress expressed by the following formula must be within the allowable working stress for the core material:

$$S_c = \frac{(S_1 + P_1) - K_3^2\,(S_1 - P_1)}{K_3^2 - 1} \qquad (5)$$

The tensile stress in the winding must adhere to the relation expressed by the following formula, in order to obtain uniform tension in each layer when the vessel is subjected to the internal pressure P_1. The tension of application is expressed as:

$$T_{ap} = S_{ap} = \left[\frac{S_w\,K_3\,(K_x^2 + 1) - 2\,K_x}{K_x\,(K_x^2 - 1)}\right] - \frac{2\,P_1}{K_x^2 - 1} \qquad (6)$$

where $K_x = R_x/R_1$ and R_x = radius of layer x being applied.

Tension in the completed coil for any value of R_x can be calculated, if desired, from the following relation:

$$S_w = S_w - \frac{P_1 R_1^2}{R_3^2 - R_1^2}\left(1 + \frac{R_3^2}{R_x^2}\right) \qquad (7)$$

Ribbon winding construction is applicable for high-pressure vessels, but requires that the maximum advantage be taken of the core material and ribbon material to obtain an economical design. The use of high tensile steel strip is to be encouraged, but maximum utilization will generally be limited by the means employed in winding.

A typical design of ribbon-wound core shell is indicated in Fig. 5. The ends of the ribbon must be securely fastened and the completed winding retained between end rings. A protective shell may be added on the outside to avoid the possibility of damage to the ribbons.

INTERLOCKED RIBBON WINDING

A method which has modified the ribbon winding pattern to render each layer capable of carrying the longitudinal forces is the Schierenbeck design.[2] This scheme endeavors to interlock the steel ribbon by means of grooved profiles (Fig. 6). The purpose is to impart axial resistance in the winding capable of carrying the longitudinal or axial forces present when the vessel is subjected to internal pressure. The method, however, requires heavy machinery and controls for applying each consecutive layer of bands properly for correct interlock, and also for grooving of the bands with rollers during application. End closures in such a construction require special attention.

The design criteria presented for ribbon-wound shell construction can be applied advantageously in the design of a vessel following the Schierenbeck ribbon pattern. The inner core may be composed of interlocked ribbons without prestress.

To take effective advantage of prestressed designs, the stress of application of each layer of ribbons over the ribbon core must follow the pattern

outlined by Eq. (6). Any deviation will necessarily require a greater composite thickness than dictated by the Eqs. (3) and (4).

MULTI-LAYER CONSTRUCTION

A method which permits the use of laminar construction is the multi-layer shell, composed of relatively thin shells. For such a multi-layer vessel, it is no longer necessary to shrink each layer over a core shell, nor is machining required. The vessel can be constructed by progressively wrapping and tightening cylindrical sheets of steel over an inner shell, and welding together the longitudinal seam of each layer added. This method has been used by A. O. Smith Corp., and is fully described by Jasper and Scudder[3].

To obtain a prestress approaching the ideal, and an ideal thickness of shell as expressed by Eq. (1), each layer added must be applied in a controlled manner to insure a stress of application as expressed by Eq. (2). Such a construction is beset with difficulties since a review of Fig. 1 reveals that the inside layers require a negative or compressive stress of application. This obviously cannot be accomplished with the present fabrication techniques. A construction approaching the ideal prestress may be accomplished by the use of a thick-wall inner core, then applying the design criteria for ribbon winding.

In cases where the stress of application cannot be accurately controlled or measured, it is recommended that the multi-layer vessel be considered a monobloc shell, to which the solid thick-wall formulas can be applied to offer a simpler solution. The economy of prestress construction, however, obviously can not be obtained.

SPIRAL CONSTRUCTION

A unique modification of prestressing a multi-layer vessel is contained in a patent of Raymond, Creech, and Feagles,[4] wherein the vessel is constructed by spirally winding a continuous shell over a cylinder, and progressively varying the tension of application to approach the prestress pattern. Such construction is, of course, limited in its scope due to restrictions imposed by the machinery required for winding and maintaining proper tension of the steel sheet. Again, it is necessary to use an inner core to obtain a prestress pattern in the spirally wound layers.

In all cases of multi-layer vessels, end closures may be attached to the full thickness without changing the prestress pattern significantly. However, since the axial loads to be carried by the vessel under internal pressure are always less than one-half of the tangential loads, further economies of construction may be realized by welding end closures to only a sufficient number of layers to carry such loads adequately. The magnitude of the working stress may be modified to accommodate the presence of a combined state of stress in the prestress section of the shell to which the closures are attached. A typical example of an economical multi-layer design is that already noted in Fig. 5, which applies to both ribbon-wound and multi-layered vessels.

AUTO-FRETTAGE METHOD

In the several types of shell design so far considered, the vessels have been constructed by combining thin shells and ribbon winding, thereby producing economies compared with solid thick-walled vessels. However, no discussion of high-pressure vessels would be complete without reference to the auto-frettage method. This consists in subjecting a solid thick-walled vessel to internal pressure high enough that the inner section of the wall is stressed beyond the elastic limit and takes a permanent set. When the internal pressure is released the outer section of the wall, which has been stressed within the elastic range, endeavors to contract. This contraction is resisted by the inner section which has assumed a larger diameter as a result of yielding. The outer section, therefore, remains in a state of residual tension, tending to compress the inner section.

The design of such a vessel requires a knowledge of stress distribution during initial stages of over-tensioning. Also behavior of the material within the plastic range must be known. It is recognized that the laws of stress distribution beyond the elastic limit depart markedly from those based on direct proportionality between stress and strain within the elastic range. In practice, the over-strain of the inner surface of the shell, depending on the material, has been limited to 2.5 to 6 percent. The system of stresses becomes involved, but must be determined if economical design is to be attained by auto-frettage. The whole process must be regulated by accurate measurement of the strains set up during the over-stressing operations.

Auto-frettage applied to a multi-layered vessel of non-prestressed construction is outlined by Kepler,[5] whereby the layers are brought into closer contact by pressuring the inside of the shell until the stresses expand the inner layers beyond the elastic limit and a permanent deformation is obtained.

STRESSING BY WELDING

A simple and convenient method of reinforcing a pressure vessel is by taking advantage of the large compressive stresses produced by welding. The construction consists in applying a deposit of weld metal spirally around a core shell, preferably by automatic welding. If the vessel is of considerable length, several weld deposits may be applied simultaneously.

The residual stresses of the welding operation are circumferential and radial compressive stresses. The longitudinal stresses may be compressive or tensile depending on the dimensions of the weld deposit and the pitch of the spiral. Although the stress distribution in the weld metal deposit is involved, the method of construction lends itself to close control by measurement of the strains produced with each layer of weld deposited. With the aid of a test specimen and strain measurements, empirical relations can be determined readily which permit the design of prestressed vessels in this way. The only disadvantage of this method is the non-uniformity of stress in the weld deposit bead, which may show variations approaching the elastic limit of the weld metal.

In concluding this discussion of design of high-pressure vessels, it should be made clear that the application of the design criteria presented permits determining only the necessary dimensions of the cylindrical shell. It cannot be over-emphasized that there are other equally important factors which must be considered in the design. Among them are: selection of material, method of manufacture, determination of correct design stress, and type of end closures to be used. Also of importance are the stress conditions under varying pressure or temperature, the corrosive nature of the vessel contents, and the practical means used in measuring the stress pattern in proper testing of the completed vessel. Development of judgment on the part of the designer best comes from actual knowledge of successful designs of high-pressure vessels already being used in industry.

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Blower and Heat Requirements of Rotary Vacuum Filter-Dryers

To filter a slurry and dry the cake takes hot air. Here is a way to calculate how much air, at what vacuum, and the amount of heat required.

L. E. BROWNELL and H. E. CROSIER

NOTE: *This is the second of two articles by Prof. Brownell and his associates. The first, last month, told how to calculate the blower requirements of rotary-drum filters.*—EDITOR.

THE TOP-FEED filter-dryer was developed to filter crystalline solids that settle too rapidly to be filtered easily in conventional bottom-feed, rotary-drum vacuum filters. Cakes from filter-dryers have high permeabilities and permit sufficient air flow to yield a dry product if preheated air is used. As a result, complete drying of the product has become a primary feature of this filter design.

Selection of the proper vacuum and heating equipment is a particularly important problem in the design of filter-dryers. The methods of calculation presented in last month's article (see note above) are extended to filter-dryers and additional relationships are developed to predict the heat requirements.

MECHANISM OF MOISTURE REMOVAL

Moisture removal in any rotary vacuum filter occurs mechanically by fluid flow, and also by vaporization. Using air at room temperature, the amount of moisture removed by vaporization is negligible compared to the amount of moisture removed by fluid flow, and the cakes from such filters are discharged moist. It is not possible to remove all the moisture from the cake by fluid flow alone, because capillary forces retain a portion of the liquid, called the residual saturation.

In order to reduce the liquid content below the residual saturation, drying must take place. Drying (vaporization) occurs simultaneously with fluid flow and may continue after fluid flow ceases. To increase the drying rate, preheated air is used. In the drying process, the liquid in a moist cake presents so great a surface that the air rapidly becomes nearly saturated with vaporized liquid. Drying starts at the outer edge of the cake, the layer of vaporization progresses inwardly as drying continues and the air leaves the cake close to the adiatic saturation temperature. There is a sharp liquid concentration gradient within this layer of vaporization, the cake above being very dry and the cake below being virtually at the residual saturation. Finally, when the layer of vaporization reaches the inner edge of the cake, all fluid flow in the cake ceases. After passing this point, the drying efficiency decreases rapidly.

DRYING EFFICIENCY

In drying the cake, the maximum amount of heat is recovered from the air if the air is cooled to the moist-cake temperature. Since the drying is an adiabatic process in which all the heat necessary for the vaporization of the liquid is supplied by the air, the air temperature follows an adiabatic path. The ratio of the actual temperature change to the maximum possible temperature change is designated as the drying efficiency.

CRITICAL MOIST CAKE THICKNESS

When the layer of vaporization reaches the inner edge of the cake, the drying efficiency begins to decrease rapidly. This break usually occurs at an efficiency of 90 percent or higher. At the break, it is believed that the thickness of the remaining moist cake is equivalent to that of the layer of vaporization. However, as the thickness of the layer of vaporization is not precisely known, an arbitrary definition of "critical moist-cake thickness" is selected in terms of the break in the drying efficiency. The critical moist-cake thickness is defined as that thickness of cake having the residual saturation at the point where the instantaneous drying efficiency is 90 percent. This assumes a uniform moisture distribution which is recognized as an approximation.

For maximum heat economy the thickness of the moist cake on the drum should not be allowed to drop below the critical thickness. The total cake thickness should be such that the sensible heat in the hot dry portion is sufficient to dry the moist portion to the desired extent, when the moist and dry portions are mixed. Therefore, in filter-dryer calculations it is necessary to predict the critical moist-cake thickness.

The critical moist-cake thickness can be predicted from the equations for the theoretical relationships for fluid flow and for drying:

FLUID FLOW RELATIONSHIPS

$S_r = 0.0126\,(K\,\Delta\,P/g\,\gamma\,\cos\theta)^{-0.264}$

$\bullet = F_1\,(K\,\Delta\,P/\mu\,L)$ See last month's article for discussion.

$R = F_1\,(D_p\,K\,\Delta\,P/\mu^2\,L\,X^m)$

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DRYING RELATIONSHIPS

$E = 1 - e^{YW}$

$Y = 1.44\,(R)^{0.265}\,(1/D_{inches})^{0.35}\,(W)^{-0.36}$ (See Ref. 1)

RELATIONSHIPS BY DEFINITION

E_c = drying efficiency at break = 0.90 (by arbitrary definition)

W_c = moisture content of cake before drying, lbs/ft² = $S_r XL\rho$ (by arbitrary definition)

L_c = critical most-cake thickness, inches = $L\,(W_c/W_o)$

The moisture content (W) may be converted to an equivalent cake thickness (L) through the relationship for residual saturation (S_r) and the Reynolds number (R) may be defined by the Darcy equation with a correction factor (F_t) for turbulence. Combining these relationships by algebraic manipulation, the critical moist cake thickness (L_c) can be expressed in terms of permeability (K), pressure gradient ($\Delta P/L$), and correction for turbulence (F_t). Using the properties of water at 130 deg. F. for the liquid, the properties of saturated air at 170 deg. F., and 27.92 in. Hg absolute pressure, 0.40 for the porosity (X), and 8 and 4 for the exponents (n) and (m), respectively, this relationship is expressed as follows:

$$L_c = 0.180\,[K^{\text{[illegible]}}/(F_t)^{0.336}\,(\Delta P/L)^{0.072}] \qquad (1)$$

Fig. 1 is a plot of Eq. (1) and is convenient for predicting the critical moist-cake thickness.

CAKE TEMPERATURES

The cake temperatures are dependent on the moisture distribution and the air temperature and humidity. For moist cakes of crystalline or granular particles in which the drying occurs from a free-liquid film surrounding each particle, the moist cake remains at the wet-bulb temperature of the air, virtually the adibatic saturation temperature. The wet-bulb temperature remains constant during drying for constant inlet-air temperature and humidity.

The temperature of the dry portion of the cake varies from the temperature of the moist portion to that of the entering air. This results from the combined heat and mass transfer which takes place during drying. The following mechanism is believed to exist. As the zone of vaporization progresses into the cake, it is followed by a zone of heat transfer in which there is a sharp temperature gradient. At the boundary between these two zones, the cake is at the wet-bulb temperature of the air. At and beyond the outer boundary of the heat-transfer zone, the cake is at the entering-air temperature.

In order to simplify the calculations, two temperatures have been assigned to the cake being dried, one for the moist fraction and one for the dry fraction. The moist fraction is assumed to be at the wet-bulb temperature of the air. The dry fraction is assumed to be at a temperature between the wet-bulb and entering-air temperature. The average temperature of the dry fraction is known to vary with conditions, and its accurate evaluation is a problem in unsteady-state heat transfer. However, the empirical relation given by Eq. (2) is based on limited data and is recom-

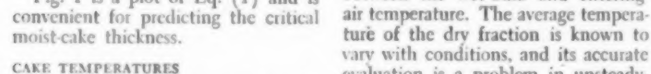


Fig. 1—Plot of Eq. (1) and is used to predict critical moist cake thickness from permeability, pressure gradient and (with last month's Fig. 4) turbulence.

NOMENCLATURE

- C_a = Specific heat of air, Btu./lb. deg. F.
- C_L = Filtration constant for a given slurry, lb. sec./ft.⁴ (See Eq. 2, last month's article).
- C_p = Specific heat of dry product, Btu./lb. deg. F.
- C_t = $\mu_L XL^2/K\,\Delta P$
- C_v = $XL\,(\mu_L/\mu_a)$
- C_{wt} = Specific heat of moisture, Btu./lb. deg. F.
- cfm = Cubic feet per minute.
- E = Drying efficiency, dimensionless (see Ref. 1).
- $E_{avg.}$ = Over-all drying efficiency.
- F_p = Average absolute pressure in cake/inlet absolute pressure to blower.
- $(F_t)_1$ = Turbulence correction factor in moist cake fraction.
- H = Humidity, lb. water/lb. dry air.
- K = Permeability, ft.³/sec.²
- L = Total cake thickness, in. = $L_1 + L_2$
- L_1 = Final moist cake thickness on drum, in.
- $L_{1\text{-}avg.}$ = Average moist cake thickness on drum, in. = $(L + L_1)/2$.
- L_2 = Final dry cake thickness on drum, in.
- $L_{2\text{-}avg.}$ = Average dry cake thickness on drum, in. = $L_2/2$.
- L_c = Critical moist cake thickness, in.
- n, m = Exponents depending on porosity and sphericity (see Ref. 2).
- p = Lbs. dry product/hr.
- ΔP = Total pressure drop across the cake, lbs./ft.²
- $\Delta P_{1\text{-}avg.}$ = Average pressure drop across moist portion of cake, lbs./ft.²
- $(\Delta P/L)_1$ = $(\Delta P/L)_{1\text{-}avg.}$ = pressure gradient in moist portion of cake, lbs./ft.² (ft.) or in. Hg/in.
- $(\Delta P/L)_2$ = Pressure gradient in dry portion of cake, lbs./ft.² (ft.) or in. Hg/in.
- s = Weight fraction of solids in slurry, lbs. solid/lb. slurry.
- S = Saturation = volume of voids filled with wetting liquid/total volume voids.
- S_r = Residual saturation = maximum volume of wetting fluid eliminated from flow/total volume voids.
- t = Time, sec.
- t' = Necessary time to deposit the cake, sec.
- T_o = Temperature of the cake entering the drying zone, deg. F.
- T_1 = Temperature of moist cake = wet bulb temperature of air, deg. F.
- T_2 = Average temperature of dry cake on drum, deg. F.
- T_a = Temperature of the air entering the filter cake, deg. F.
- T_e = Temperature of the air leaving the cake, deg. F.
- T_p = Average temperature of final exit product (mixed), deg. F.
- T_{wb} = Wet bulb temperature of the preheated air, deg. F.
- V = Accumulative volume of air ft.³/ft.²-cycle.
- w_1 = Moisture content of moist cake to be removed by drying, lbs. moisture/lb. dry cake.
- W_a = Air flow through cake in drying zone, lb. dry air/min.
- X = Porosity of dry product, volume voids/volume cake.
- λ_1 = Latent heat of vaporization of water at T_1, Btu./lb.
- ρ = Density of filtrate, lbs./ft.³
- ρ' = Density of solid particles, lbs./ft.³
- μ_a = Viscosity of air, lbs./ft.-sec.
- μ_L = Viscosity of filtrate, lbs./ft.-sec.

mended for the approximate evaluation of the average dry-cake temperature (T_2):

$$T_2 = T_a - 0.2\ (T_a - T_{wb}) \qquad (2)$$

AIR TEMPERATURE

The hot air supplied to the filter-dryer loses some heat by radiation and convection. Data on commercial installations indicate that the heat loss for air at 900 deg. F. is about 50 deg. F.; for 600 deg. F. air, 30 deg. F.; and for 300 deg. F. air, 15 deg. F.

The air remains at virtually the inlet temperature while it passes through the hot, dry portion of the cake. It gives up heat in the heat-transfer and vaporization zones, and leaves at a temperature somewhat above the adiabatic saturation temperature. For a selected over-all drying efficiency the temperature of the air leaving the cake (T_e) is given by Eq. (3) (based upon the definition of drying efficiency):

$$T_e = T_a - E_{avg.}\ (T_a - T_{wb}) \qquad (3)$$

If the moist-cake thickness is kept above the critical value (L_c), over-all drying efficiencies ($E_{avg.}$) of about 0.95 may be expected.

In almost all filter-dryer installations the temperature of the air leaving the trunnion is close to the wet-bulb temperature.

ENTHALPY BALANCES

Enthalpy Balance to Determine the Thickness of the Moist Portion of the Cake Leaving the Drum:

If a completely dry product is desired, the final temperature of the product leaving the filter-dryer should be fairly close to the boiling point of the wash liquid. For partially dried products, the temperature will be lower in proportion to the desired moisture content.

By an enthalpy balance in which the loss of sensible heat of the cake is equated to the quantity of moisture vaporized, it is possible to determine the moist fraction of the cake leaving the drum. Assuming no heat losses and complete vaporization of liquid in the moist fraction of the cake, the balance takes the form of Eq. (4), based on unit area of cake and the moist-cake temperature as the reference.

Sensible heat in dry cake = sensible heat in product + heat of vaporization of the liquid in the cake.

$$L_2\ (C_p)\ (T_2 - T_1) = L\ (C_p)\ (T_p - T_1) + w_1\ \lambda_1 L_1 \qquad (4)$$

Eq. (4) may be used to calculate the final moist-cake thickness (L_1). The value of L_1 should be kept above the critical moist-cake thickness (L_c) for economical operation.

Enthalpy Balance to Determine the Air Flow Required:

A second heat balance, this time between the entering air and the moisture vaporized from the filter cake, permits the calculation of the air requirements. This balance is shown by Eq. (5), below, and expressed in words as follows: Heat from the air to the cake (per minute) = Lb. of cake per minute × the sum of: sensible heat to bring the wet cake to the wet-bulb temperature + latent heat of vaporization for liquid evaporated at wet-bulb temperature + sensible heat to the dry portion of the cake.

$$W_a E_t\ (T_a - T_{wb})\ (C_a) = (p/60)\ [(C_p + w_1 C_{wl})\ (T_{wb} - T_c) + w_1\ (L_1/L)\ \lambda_1 + (L_2/L)\ (C_p)\ (T_2 - T_{wb})] \qquad (5)$$

In solving Eqs. (4) and (5), it is necessary to know the moisture vaporized from the cake (w_1). This moisture is slightly greater than the residual saturation (S_r) of the cake, as the time in the dewatering and drying zones is not sufficient to reduce the liquid in the cake to the equilibrium value of S_r. However, the approach to the residual saturation is so close that (S_r + 0.01) is recommended as an approximation. This value may be checked by calculating the final saturation ($\bar{S}$) after the pressure drop (ΔP) has been established. The moisture content to be vaporized (w_1) can be calculated from this approximation of S as follows:

$$w_1 = [S_r + 0.01][X/(1 - X)][\rho/\rho'] \qquad (6)$$

CALCULATION OF PRESSURE DROP

During drying the pressure gradients will not be the same in the moist and dry portions of the cake because of the differences in the air temperatures, viscosities, and densities. However, the mass rate of flow is the same in both portions and is equal to the air flow (W_a) calculated by Eq. (5).

It is possible to calculate the pressure gradient in the moist fraction by the methods given in last month's article, using the average thickness of the moist layer and the previously determined air rate. The rate of drying is uniform if the moist cake thickness remains greater than the critical, so that the average thickness of the moist layer may be taken as the arithmetic mean of the initial and final thicknesses of the moist layer.

The resistance to flow in the dry portion differs from that in the moist portion because of viscosity and density differences of the air. Since the viscosities and densities are expressible as functions of temperature, the Reynolds numbers of the air in the two portions of filter cake may be related by their temperatures, the other variables being constant. From the Reynolds numbers the corresponding friction factors may be evaluated and the pressure gradients may be calculated.

For convenience, these calculations are presented in Fig. 2, which gives the relationship between the pressure gradients in the moist and dry portions of the cake as a function of the turbulence factor (F_t), and the ratio of air temperatures in the two portions. The turbulence factor (F_t) may be obtained from Fig. 4 of last month's article. The inflections of the curves in Fig. 2 are the result of transition from laminar to turbulent flow.

Using the pressure gradient in the moist fraction, the ratio of the pressure gradients, and the average thicknesses of both portions, the total pressure drop (ΔP) may be calculated by Eq. (7).

$$\Delta P = [(L + L_1)/2]\ (\Delta P/L_1) + (L_2/2)\ (\Delta P/L)_1\ [(\Delta P/L)_2/(\Delta P/L)_1] \qquad (7)$$

VACUUM PUMP CAPACITY

The air required for drying, (W_a) is essentially the air passing to the vacuum pump. However, for more rigorous calculations, the water evaporated and the air flow during cake deposition, first dewatering, washing, and second dewatering should be added to the preheated air (W_a). For practical purposes the air flow during cake deposition can be neglected. The air flow during dewatering and washing is small compared to that during drying, and is usually about 10 to 20 percent of the total. The air flow during these periods may be calculated by the methods in the previous article.

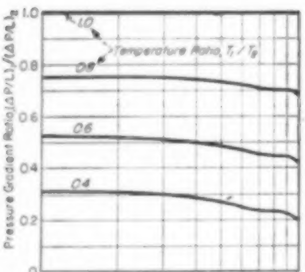


Fig. 2—Gives ratio of pressure gradients in moist and dry portions of cake.

EXAMPLE CALCULATION

The following problem is included to show the method of calculation.

Washed, wet, foundry sand is to be dried on a rotary-drum filter-dryer. For the given conditions, calculate the exhauster capacity and the heat requirements.

Tabulation of Results:—

	Observed in Commercial Installation for Conditions Given	Calculated
Exhauster Intake		
Vacuum, in. Hg	3¾-4	4.10
Air Flow, cfm.	3,116	3,190
Heat Requirements		
Gas Rate (600 Btu./ft.³, 535 Btu./ft.³ net), cfm.	40	37.3

Operating Conditions Selected:— Product is 5.2 tons per hr. of dry foundry sand. Air temperature from preheater is 630 deg. F. Feed temperature is 60 deg. F. Feed composition is 0.20 lb. sand per lb. slurry. Filter area is 25 sq. ft. Cycle time is 99 sec. per revolution. Cycle is shown in this drawing; room temperature air is used during deposition and dewatering, preheated air for drying.

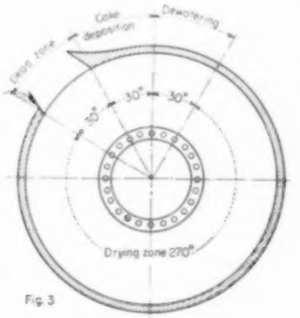


Fig. 3

Final moisture content in product is 0.00 percent. Final average temperature of dry product is 180 deg. F.

Approximations:— (1) Air undergoes a 30 deg. F. radiation and convection loss between the preheater and the filter. $T_a = 630 - 30 = 600$ deg. F. (2) Air enters the preheater at 70 deg. F. at relative humidity 60 percent, and humidity 0.009. (3) Air preheater is direct-contact type (i.e., products of combustion mix with the entering air). However, the mixture has essentially the same properties as air. (4) Wet-bulb temperature of the preheated air is 130 deg. F. (5) Average drying efficiency equals 95 percent, i.e., $E_r = 0.95 = (T_a - T_e)/(T_a - T_{wb}) = (600 - T_e)/(600 - 130)$. From this $T_e = 154$ deg. F. (6) All moisture below a saturation of $(S_r + 0.01)$ must be vaporized in the drying zone. (7) Average temperature of dry portion of cake on the drum is: $T_s = T_a - 0.2\ (T_a - T_{wb}) = 600 - 0.2\ (600 - 130) = 506$ deg. F.

*Filter Cake Data:—*Density of sand particles, $\rho' = 165$ lb./ft.³ Porosity of dry sand, $X = 0.40$ (estimated). Residual saturation, $S_r = 0.238$ (from experimental data). Average permeability, $K = 2.46 \times 10^{-9}$ (from experimental data). Heat capacity of sand, $C_p = 0.20$ Btu/deg. F. lb. dry sand. Solids in slurry, $s = 0.20$ lb. sand/lb. slurry.

Air Properties:—(1) Dewatering Zone: dry-bulb temperature = 70 deg. F.; wet-bulb temperature = 60 deg. F.; viscosity, μ_a, at wet-bulb temperature = 0.0176 c.p. (2) Drying Zone: temperature leaving moist cake, T_e = 177 deg. F.; viscosity, μ_a, at 154 deg. F. = 0.0197 c.p. (3) Filtrate (Water): viscosity in cake deposition and dewatering zones (60 deg. F.) is 1.13 c.p.; viscosity in drying zone (130 deg. F.) is 0.512 c.p.; vapor pressure of water (130 deg. F.) is 4.525 in. Hg; density in cake deposition and dewatering zones is 62.4 lb./ft.³; density in drying zone (130 deg. F.) is 61.5 lb./ft.³

Calculations:

(1) Actual Thickness of Deposited Cake: thickness, $L = [(5.2 \times 2{,}000)/3{,}600] \times 99 \times [12/165\ (1 - 0.4)25] = 1.385$ inches.

(2) Moist Fraction of Cake Leaving Drum (Basis: Unit area of cake and moist cake temperature as the reference): First, $S = (S_r + 0.01) = (0.238 + 0.01) = 0.248$; substituting in Eq. (6), $w_1 = 0.248\ [0.40/(1 - 0.40)]\ [61.5/165] = 0.0616$; and putting this in Eq. (4), $(1.385 - L_1)(0.20)(506 - 130) = (1.385)(0.20)(180 - 130) + (0.0616)(1{,}025.8)(L_1)$ from which $L_1 = 0.625$ inch, and $L_2 = L - L_1 = 1.385 - 0.652 = 0.733$ inch.

(3) Check of Final Moist Fraction Against Critical Moist-Cake Thickness: L_c from Fig. 1 (at $K = 2.46 \times 10^{-9}$ and $(\Delta P/L)$ from 1 to 10 in. Hg/in. cake) is about 0.110 in., which is less than the final L_2. Therefore an average efficiency of 90 percent is valid.

$$L_{1\text{-avg.}} = \tfrac{1}{2}(L + L_1) = \tfrac{1}{2}(1.385 + 0.652) = 1.018 \text{ in.}$$

$$L_{2\text{-avg.}} = L_2/L = \tfrac{1}{2}(0.733) = 0.367 \text{ in.}$$

(4) Air Flow in Drying Zone: Substituting known values in Eq. (5), $W_a = [10{,}400/60]\ [(0.20 + 0.0616 \times 1)\ (130 - 60) + (0.0616)(0.733/1.385)\ (1{,}025.8) + (0.733/1.385)\ (0.20)\ (506 - 130)]/[(0.90)(600 - 130)\ (0.24 + 0.060 \times 0.45)] = 140.2$ lb. dry air per min. (Using H of air out = H of air saturated at 130 deg. F., one atmosphere = 0.1105 lb. H_2O/lb. dry air. H of air in = 0.009 lb. H_2O/lb. dry air. $H_{avg.}$ = 0.060 lb. H_2O/lb. dry air.)

(5) Calculation of Pressure Gradients: Assuming average vacuum in moist zone = 3 in. Hg: $V = [(140.2/60)\ (99)\ (1.060)]\ [359/(29 + 0.60 \times 18)\ (1/1.06)]\ [(460 + 177)/492]\ [29.92/26.92]/[25(270°/360°)] = 237$ ft.³/ft.²-cycle. Substituting in Eq. (15) of last month's article, $C_v = XL_{1\text{-avg.}}\ (\mu_L/\mu_a) = (0.40)\ (1.027/12)\ (0.512/0.0197) =$

(Continued on page 170)

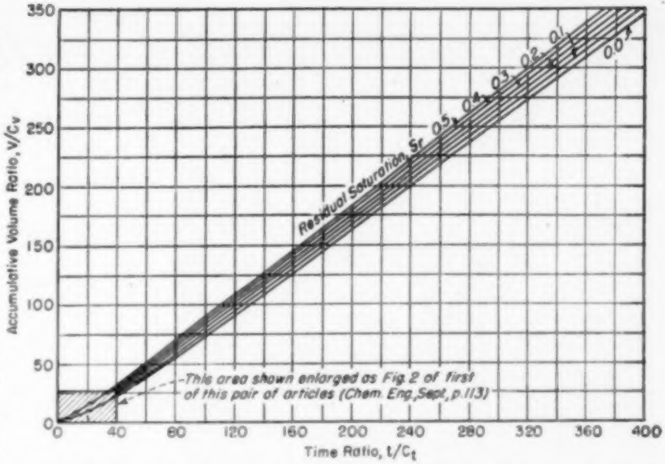
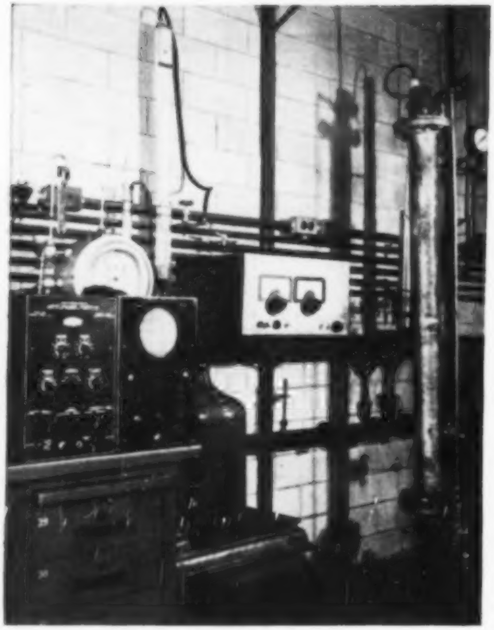


Fig. 4—Integrated air-rate curve (high range) showing the air flow V as a function of the filtration constant C_v, time ratio t/C_t and residual saturation S_r.



APPARATUS in which the weight-ratio experiments were made.

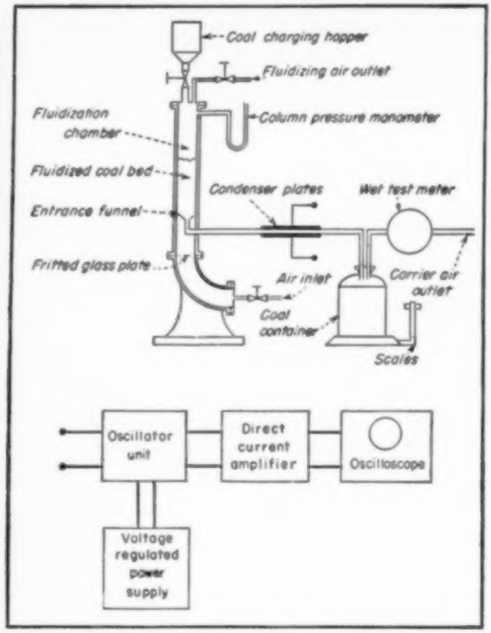
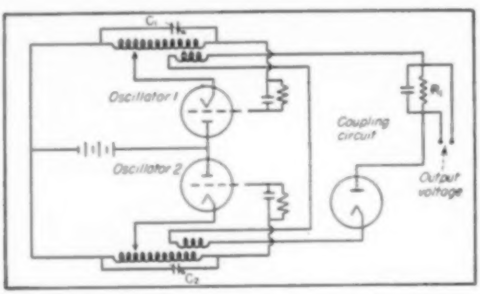
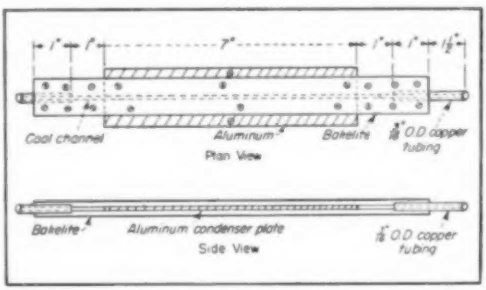


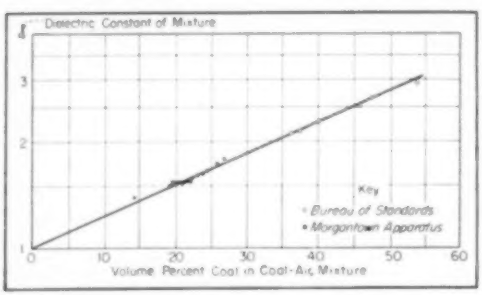
DIAGRAM of the apparatus and associated electronic circuit.



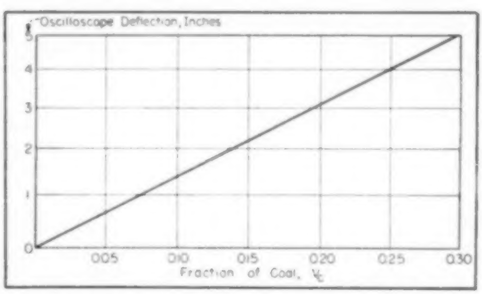
CIRCUIT (simplified) for measuring change in dielectric constant.



CONDENSER through which the coal-air mixture was passed.



PROOF that the dielectric constant varies with composition.



CALIBRATION relates oscilloscope reading and coal volume.

New Method Measures the Solid:Gas Ratio in High-Solid Flow

An electronic method has been developed for measuring the instantaneous solid:gas flow through a tube when the solid is about 20 percent by volume. It detects a change of about 1 percent solids by volume.

J. M. DOTSON, J. H. HOLDEN, C. B. SEIBERT, H. P. SIMONS and L. D. SCHMIDT

In our studies on the flow of extremely dense coal-air mixtures (about 200 lb. of coal per lb. of conveying air) we needed a method of measuring the instantaneous ratio of coal to air. The purpose of our studies was to assure a constant rate of coal feed to a reactor in which the coal is gasified with steam and oxygen. Residence time of the coal in the gasifier is only about a second. It is therefore important to keep the ratio of coal to gasifying agent constant.

An electronic instrument was developed for measuring the coal:air ratio over short time intervals so that the steadiness of the coal flow could be measured.

It should be useful in measuring the uniformity of mixing of any pulverized solid and gas provided the concentration of the solid is high enough to make the dielectric constant of the mixture measurably higher than that of the gas alone.

Our new instrument does not measure the rate of coal flow; it measures the homogeneity of the flowing mixture of coal and air. Since the mixture flows as a fluid, its rate will be constant (1) if the pressure drop causing the flow is constant, (2) if the mixture is homogeneous. The instrument was designed to have a high speed of response so that measurements over short time intervals could be made and so that it could give a picture of the variations in the coal:air ratio. This allows us to evaluate the various methods of improving the homogeneity of the mixture.

The method measures the change in dielectric constant of the coal-air mixture as it flows between the plates of a condenser. Measurement of an electrical property has the advantage of a high speed of response; those with mechanical movements of the measuring device are much slower. By using an oscilloscope as the recorder, there is no time lag and the variation of the measurement with time is recorded.

The change of the dielectric constant of a mixture of dust in gas over that of the gas alone has been suggested as one way to measure the dust concentration.[1] In previous cases it was found inapplicable because the capacitance change caused by the presence of the small amount of dust (as a fraction of the total volume) was too low to measure. The change in dielectric constant from all-air to 20 percent coal and 80 percent air by volume is about 0.5 mmfd. (corresponding to a 40 percent change in the effective capacity of a condenser). This change is large enough to be measured in the condenser used.

HOW THE CIRCUIT WORKS

Measurement of capacity requires an oscillating circuit; several of these have been described.[2] The circuit used in our instrument was adapted from one described by Potter.[3] It uses two synchronized oscillating circuits that are coupled inductively.

A simplified circuit diagram is shown (p. 128). *When oscillators 1 and 2 have the same frequency and phase, no current flows in the inductively coupled circuit. The latter is shown beside the oscillating circuits. If the capacity of C_1 (which is in the circuit of oscillator 1) is changed, the two oscillators are no longer in phase. A current then induced in the coupling circuit is proportional to the phase difference. It is therefore a measure of the change in capacity of condenser C_1. The high-frequency current in the

A cooperative development of the Bureau of Mines and West Virginia University. J. M. DOTSON was a student in chemical engineering at West Virginia University where C. B. SEIBERT is associate professor of electrical engineering and H. P. SIMONS is professor of chemical engineering. J. H. HOLDEN is a chemical engineer with the Synthesis Gas Production Branch of the Bureau of Mines' Office of Synthetic Liquid Fuels; L. D. SCHMIDT is chief of the Branch. All are at Morgantown, W. Va.

* A complete circuit diagram can be obtained from the U. S. Bureau of Mines, Morgantown, W. Va.

Oscilloscope readings—inches deflection above the datum line—are converted into volumetric fraction of coal in the mixture to check homogeneity.

coupling circuit is rectified by the diode. Voltage drop across a resistor (R_1) is used to measure this current.

Information from Potter[4] on his circuit indicated that a voltage drop of 30 m.v. could be obtained across 1,000 ohms resistance from a capacitance change of 0.02 mmfd. (or a change of about 1 percent in the volume of coal). Since this voltage change was to be measured by a vertical deflection on an oscilloscope, an amplifier was necessary to get a measurable deflection of about 0.1 in. for a 1 percent change by volume in the coal-air mixture. The measured capacitance change was small; it is therefore necessary to have a constant line voltage.

THREE-UNIT CIRCUIT

The complete circuit has three units: (1) A power-supply unit which gives a constant voltage input for the oscillators and the amplifier, (2) the oscillators and the coupling circuit which measure the capacity change, and (3) a direct-current amplifier for the voltage input to the oscilloscope. The frequency of the oscillator circuits is 1.5 megacycles. The condenser (C_x, not shown) through which the coal-air mixture flows is in parallel with C_1. Condensers C_1 and C_2 were used to calibrate the apparatus since a change in C_1 is equivalent to a change in C_x. The voltage drop in the coupling circuit is measured.

Coal condensers (see cut) were made of aluminum plates separated by Bakelite strips. The passage through which the coal-air mixture flows is about 0.1 in. square in cross-section by 7 in. long. Capacity of the effective part of this condenser was calculated to be 1.176 mmfd. when it contained air.

Amplified and unamplified voltages were measured with a voltmeter as C_1 was varied over the range to be used in measuring the coal:air ratio. The amplified and unamplified voltage outputs and the deflection in inches on the oscilloscope were found to vary linearly with the capacitance change of the condenser. The capacitance change of condensers C_1 and C_2 was measured with a radio-frequency bridge and found to be linear over the range used. The value of C_1 was found by calibration to be 0.0283 mmfd. per division.

CALIBRATION WITH COAL

A coal-air mixture was blown through the condenser from a pneumatic feeder[5] developed by the U. S. Bureau of Mines at Morgantown, W. Va., for feeding coal to a reactor. The feeder operates by (1) forming a fluidized bed of coal under pressure, (2) bleeding off most of the fluidizing air from the top of the container, and (3) causing the coal-air mixture to flow from the bed through a coal-delivery tube to the point of use. Around the entrance to the coal delivery tube is a shield that gives a bed of uniform density by partial settling of the coal. Coal flows from the tube through the condenser in the oscillating circuit. The output voltage, which is recorded on the oscilloscope, measures the coal:air ratio in the tube. At the rates of flow used in the experiments, any coal particle was in the condenser between 0.05 and 0.1 sec.

The dielectric constant of a mixture of finely divided solid randomly spaced in a gas has been reported[6] to follow the equation: $\log D_m = V_s \log D$, where D_m is the dielectric constant of the solid-gas mixture; V_s is the volumetric fraction of solid in the mixture; and D is the dielectric constant of the solid. To test if this relation would apply to coal-air mixtures, we made simultaneous measurements of the coal:air ratio and the deflection on the oscilloscope. The coal-air mixture from the feeder was passed through the condenser and the average deflection on the oscilloscope determined. The coal was then caught and weighed in a container; the conveying air was measured by a wet test meter.

The test data are shown. The logarithm of the dielectric constant of the mixture has been plotted against the volumetric percent of coal in the mixture. The experimental data are marked with dots. Points marked with circles are determinations made on a sample of the coal by the National Bureau of Standards through the courtesy of Charles Moon.* The logarithmic relation is shown to hold for the coal used in these experiments. This coal has a density of 86.7 lb. per cu. ft. and a screen analysis of 89.1 percent through a 200-mesh Tyler Standard. It has 0.9 percent moisture.

Also shown is a plot of the deflection on the oscilloscope against the volumetric fraction of coal in the mixture passing through the condenser.

USE OF THE INSTRUMENT

The instrument was used to determine the effect of a shield around the feed inlet on the coal:air ratio of the mixture flowing through the coal delivery tube from the pneumatic feeder already described.[5] The time required for the spot to move across the field of the oscilloscope was in all cases 1 second.

The volumetric fraction of coal in the mixture is found from the distance of the spot above a datum line. The shield effects uniformity of the mixture flowing through the tube.

Use of the instrument is restricted to solid:gas ratios that are high enough to cause a measurable change in the capacity of the condenser. Greater sensitivity can be gotten by increasing (1) the length of the condenser, (2) the amplification ratio or (3) by decreasing the inductive coupling between the oscillators. However, in the last two cases, errors are also multiplied; and extreme care would be necessary to eliminate the effects of changes in line voltage and temperature changes. The effective range of solid concentrations is above about 5 percent by volume when the solid has a dielectric constant similar to that of coal. This minimum effective range may be lowered by using a solid such as titanium dioxide, which has a dielectric constant of 80 (about 10 times that of coal).

The probable minimum variation in a high dielectric constant material that could be detected is about 0.1 percent solid by volume. At high solid concentrations, however, the instrument has proved to be very effective in measuring changes in the solid:gas ratio.

* Chief, Inductance & Capacitance Section, Division of Electricity & Optics.

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1 White, H. J. Research Corp., personal communication, Nov. 19, 1948.

2 Roberts, H. C. "Electrical Gaging Methods for Strain, Movement, Pressure and Vibration." *Instruments*, 17, 192, 260, 284 (1944).

3 Potter, E. V. "An Electrical Transducer Circuit for Use with Capacity Pick-Up Devices." *Review of Scientific Instruments* 14, 130 (1943).

4 Potter, E. V. Personal communication, Oct. 7, 1948.

5 Albright, C. W., Holden, J. H., Simons, H. P., Schmidt, L. D. "Pneumatic Feeder for Finely Divided Solids." *Chemical Engineering* 56, 108-111, June 1949.

6 Argue, G. H. and Maass, O. "Measurement of the Variation of Dielectric Constant of Water with Extent of Adsorption." *Canadian Journal of Research* 13-B, 156-166 (1935).

The Plant Notebook

THEODORE R. OLIVE, Associate Editor

Chart A—Evaporation Factor							
Feed liquor Baumé at op. temp.	Evap. discharge Baumé at operating temp.						
	24	25	26	27	28	29	30
	Evap. factor, lb. H_2O evap./lb. feed						
7.5			0.66				

Chart B—Water Evaporation						
Evaporator feed, Gpm	Evap factor, lb. H_2O evap./lb. feed					
	0.63	0.64	0.65	0.66	0.67	0.68
	Thousands of lb. water evap. per hour					
520				180		

Chart C—Evaporator Economy							
1,000 lb. water evap. per hour	Thousands of lb of steam used per hour						
	34	35	36	37	38	39	40
	Economy, lb. H_2O evap/lb steam used						
180			5.0				

Three Simple Charts Aid Economy Calculations for Evaporators

Murry L. Oliver, *Research Chemist, Hopewell, Va.*
***August Contest Prize Winner**

In the operation of evaporators it is frequently necessary to calculate the evaporator economy. The economy of an evaporator may be measured by the number of pounds of water evaporated per pound of steam supplied. This calculation usually requires the service of a chemist or engineer. By the use of three charts it is possible for anyone operating an evaporator to compute the economy within 2 min.

Almost all evaporator operators record hourly on a log sheet the important data necessary for operation; namely, the thousands of pounds of steam used per hour, gallons per minute of feed liquor flow, and hydrometer readings of the feed and discharge liquors. From these facts the operator can compute hourly the evaporator economy by the use of three charts, *A*, *B*, and C, which are skeletonized above for illustration.

In Chart A it is necessary to establish curves of density (Baumé) versus percent solids of the evaporator feed and discharge liquors at temperatures as used in operation. The Baumé reading will then represent definite percent solids. The feed liquor is tested with a Baumé hydrometer marked in tenths, and the discharge liquor with a hydrometer marked in whole numbers. For illustrative purpose, assume that the feed liquor of 7.5 deg. Bé. at the temperature of operation contains 15.6 percent solids, and that the discharge liquor of 26 deg. Bé. at the temperature of operation contains 46.0 percent solids. Applying these percentages to the evaporation factor formula

$$1 - \frac{\text{percent solids in feed liquor}}{\text{percent solids in discharge liquor}}$$

will give 0.66 lb. of water evaporated per pound of evaporator feed liquor.

In Chart *B* it is necessary to take an average density of the feed liquor and apply this density to the various gallons-per-minute feed liquor flow rates. To illustrate the chart, assume 8.8 lb. per gal. The gallons-per-minute feed liquor flow rate, multiplied by the density times 60, will give the pounds of feed liquor per hour to the evaporator. The pounds of feed liquor per hour multiplied by the evaporation factor (from Chart *A*) will give the pounds of water evaporated per hour by the evaporators. The pounds of water evaporated per hour is expressed in thousands of pounds, and to the nearest five-thousand digit.

In Chart C the thousands of pounds of water evaporated per hour, divided by the thousands of pounds of steam used per hour, will give the over-all evaporator economy. The economy is computed to the nearest tenth.

To illustrate how to use the charts, consider this example:

Let the evaporator feed liquor = 7.5 deg. Bé. at the temperature of operation; the evaporator discharge = 26 deg. Bé. at the temperature of operation; the feed liquor flow rate = 520 gpm; and the steam usage = 36,000 lb. per hr.

The feed and discharge Baumés applied to Chart A will give the evaporation factor of 0.66. The evaporation factor of 0.66 and the evaporator feed flow of 520 gal. per minute applied to Chart *B* will give 180,000 lb. of water evaporated per hour by the evaporator. The 180,-

★ SEPTEMBER PRIZE WINNER—A $50 prize will be issued to . . .
WALTER G. THOMSON
Minneapolis, Minn.
. . . for an article describing a method of building a pilot light for high velocity combustion processes which cannot be blown out under any conditions. This article has been judged the winner of our September contest. It will appear in the November Plant Notebook.

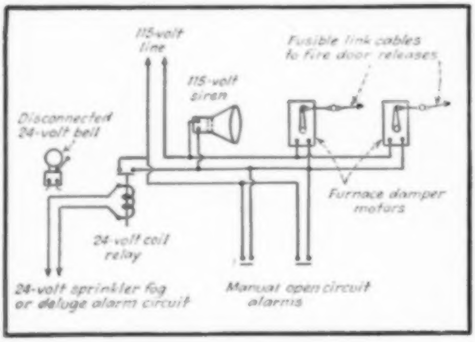
$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering*, will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook.
The winner each month will be announced in the issue of the next month, e.g., the September winner will be announced in October and his article published in November. Judges will be the Editors of *Chemical Engineering*. Nonwinning articles submitted for this contest will be published if acceptable at usual space rates.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Articles may deal with any sort of plant or production "kink" or short-cut that will be of interest to chemical engineers or others in the process industries.
Also, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

000 lb. of water evaporated per hour and the 36,000 lb. of steam usage per hour applied to Chart C will give 5.0 as the over-all evaporator economy.

Anyone desiring to construct Charts A, B, and C should establish curves of density versus percent solids of the evaporator feed and discharge liquors at temperatures as used in operation. The density of most evaporator feeds will vary within 1 or 2 deg. Bé. Therefore, in most evaporator operation an average density can be used without introducing a serious error.

This short-cut method of computing the economy should be of considerable value to the operators as a guide to evaporator performance.



How Fire Safety System Was Improved at Small Expense

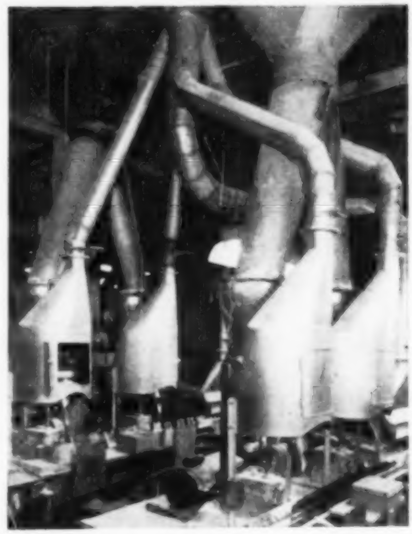
James Smith, *Plant Engineer, Sinclair & Valentine Co., Chicago, Ill.*

In one section of our plant which manufactures printing inks and allied materials containing flammable solvents, a fire alarm system had been developed using a small bell, connected to a flow switch on the deluge sprinkler system. This bell could be heard only with difficulty in the plant proper. It was also impossible to notify workers in other sections of the plant if emergency help was needed in case of fire.

To eliminate this condition, the 24-volt bell was disconnected and a 24-volt relay was connected in its place to operate a 115-volt siren. In addition, several manual alarm buttons were installed, which workmen could use to obtain help before the sprinkler system took effect.

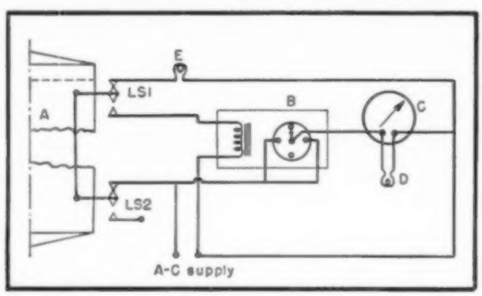
As a method of sealing fires within the area involved the fire doors were balanced with weights, through a bimetal link, which would fuse and close the doors automatically. This is the usual method of operating such fire doors. To improve this method of operation I designed a system which allows these doors to be released through a simple furnace damper motor, as illustrated in the accompanying diagram. Thus the sprinkler and siren alarm described above activate the door release before the fusible links have a chance to melt. This can come about either through action of the flow switch in the sprinkler system, or thorough manual operation of one of the alarm buttoms.

In either event it is now possible for the fire doors to be closed much sooner than by the old system, thus adding a wide margin to their usefulness as safety factors. The new arrangement requires only that the cable containing the fusible link be slipped over the operating lever of the damper motor so that it will slip off and release the door when the motor operates.



Novel Hoods Remove Dust From Filling Machines

Gilliam Packaging Co., of Cleveland, which mixes and packages chemicals for industrial use, has an unusual appearing installation of hoods to pick up the dust produced by a variety of packaging machines. The machines are ventilated by an in-draft of air into the bottoms of the hoods, produced by an exhaust fan discharging to a Sly dust filter. Hoppers above, from which the filling machines are charged, are also hooded on three sides and the top. At the extreme right is a hood extending around one side of the discharge gate of a bag filling machine, picking up float dust by the cross draft.



Automatic Indicator Checks Feed Pump Operation

D. J. Breeze, *Plant Development Dept., Monsanto Chemicals Ltd., Ruabon, Wales.*

In the February 1949 Plant Notebook, G. A. Coleman described a calibrating system for variable-volume chemical feeders, permitting easy routine checking. Readers may be interested in a different method of accomplishing this job which has been worked out by our instrument department.

In the sketch, *A* is a head tank, charged batchwise, which feeds to either of two metering pumps. The circuit and instruments in the sketch indicate to an operator supervising the main control panel how long the metering pump takes to deliver a known volume of liquid. Incidently, at the same time they tell when the tank needs refilling, and when it has been filled to the correct level.

In the sketch, LS1 and LS2 are level switches. In the type used, the switch contacts are operated magnetically by a float, each float and switch assembly being a self-contained unit which screws into a boss on the side of the tank. The switches are suitably mounted on the tank so that one is just below the maximum liquid level, and the other just above the minimum level. Device *B* is a relay-operated selector switch with an even number of contacts. The "finger" moves forward one step each time the relay coil is energized. Unit C is an electric stop clock mounted on a control panel, while *D* and *E* are panel-mounted signal lamps.

Here is how the cycle operates:

1. The operator pumps liquid into the head tank *A* until the upper contacts of LS1 close, causing lamp *E* to light. The lower contacts of LS1 open. Contacts of LS2 are closed and the selector switch finger *B* is on the neutral contact.

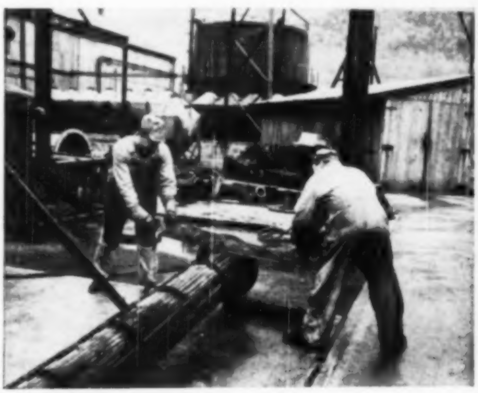
2. The metering pump now lowers the tank level to LS1, when its upper contacts open. Lamp *E* goes out, the lower contacts of LS1 close, the relay coil is energized and the selector switch finger moves to the live contact, starting the stop clock.

3. The tank level reaches LS2, the contacts of which open. The relay coil is de-energized and the stop clock stops. Signal lamp *D* goes out, showing that the tank needs recharging. The operator notes the stop clock reading, which tells him whether the metering pump rate is correct, then resets the clock to zero.

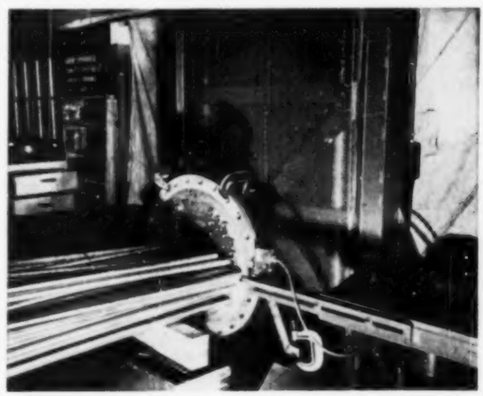
4. The tank is refilled by the operator. As the level reaches LS2, the contacts of this switch close. Hence the relay coil is energized, the selector switch finger moves to the neutral contact; the clock is unaffected.

5. The tank level continues to rise to LS1, at which point the lower LS1 contacts open, while the upper contacts close. The cycle repeats.

To help the operator in checking the metering pump rate he is provided with a table which correlates clock time with pump delivery rate, based on previous calibration of tank A with water.



BEFORE: Manpower



AFTER: Horsepower

Acetate Plant Develops Saw for Salvaging Heat Exchangers

Research and engineering skill have outmoded the troublesome, back-breaking job of sawing heat exchanger tubes at the acetate rayon plant of E. I. du Pont de Nemours & Co., at Waynesboro, Va.

Torches, manual hack saws, and crosscut saws, which were formerly used in the reclaiming of shell and tube and hairpin type heat exchangers, have been replaced by a labor-saving power band saw.

The new device, which was built by the Wells Manufacturing Co. of Three Rivers, Mich., after extensive research and experimentation by Du Pont and Wells men, will saw 48-in. diameter tube bundles, 24-in. diameter stainless steel, and 12-in. diameter copper bundles. The installation, which has been in use for about a year, has been virtually free of trouble.

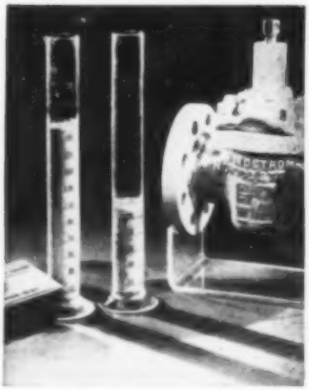
Tube replacement is frequently necessary due to the corrosive nature of some of the process materials. Removal of the tubes in a manner which permits re-use of tube sheets and baffles has formerly been accomplished with manual hack saws and crosscut saws. When the latter were used, a three-man team formed a group. While two men sawed, a third man sharpened saws. Frequent changes of saws were necessary.

In some cases, tube bundles had to be cut with a torch, followed by sawing and facing in a lathe to secure a tube stub which could be driven from the tube sheet.

The Wells power band saw has been adopted in other Du Pont plants for reclaiming heat exchanger equipment. W. F. Lawless, works engineer at the Waynesboro plant, originated the idea of the power band saw and H. C. Moss, materials of construction consultant of Du Pont's Engineering Department, worked with the Wells Manufacturing Co. to perfect the device.

Process Equipment News

THEODORE R. OLIVE, Associate Editor


Graduates show relative quantities of new (left) and old lubricants that can be stored in a plug valve.


Valve can be lubricated and re-lubricated as needed, either with stick lubricant or by a grease gun.

This Month . . .

To make sure you won't miss them, here are some of the high-lights of later pages . . . If your problem is measuring the thickness or unit weight of rapidly moving web material, such as coated fabrics or plastic films, the **beta ray recording gage** on p. 136 may be your answer . . . Or if plug valve wear has been giving trouble, you will be interested in the valve with the split **wear-compensating plug** on p. 136 . . . Do you know how the mathematician's "horn angle" is used to produce tremendous pressure in a new **roller press** now being developed commercially for expressing liquids from solids, milling powders, breaking down fibrous materials for further processing? If not, then see p. 138 . . . Is **infinitely variable speed control** from zero up needed in one of your operations? You'll be interested in how a new a.c. system does the job without electronics. See p. 140.

Next Month . . .

We're working on a lot of interesting new ideas for your next month's fare. To select a few at random . . . **a waterless gas holder** without the usual seals or sliding parts . . . a new idea in **chemical valves** using a self-lubricating plastic seal to provide complete corrosion protection . . . a novelty in **automatic electroplating**. See you then?

Compressible Lubricant Makes Plug Valve Lubrication Automatic

Nordstrom's new Hypermatic lubricant feeds under own pressure, making frequent servicing unnecessary

What is believed to be the first compressible fluid of liquid-like characteristics is the new valve lubricant, Hypermatic, just announced by Nordstrom. A development of George F. Scherer, company director of research, the new lubricant is described as the result of a 20-year search for a satisfactory method of producing automatic lubrication of plug type valves. Because it is compressible (or "energizable" as the company describes it) Hypermatic can be injected into a valve, thereafter feeding automatically through its own pressure into the internal ducts and channels of the valve. When eventually the pressure becomes too low, it can be regenerated by turning the lubricant screw, or by adding more lubricant, either in stick form, or by grease gun.

No added investment in equipment or attachments is needed to use the new lubricant which can be applied, it is estimated, in 75 percent of all the pressurized plug valves now in service. Depending on the service, the frequency of lubrication is said to be reduced to from 1 to perhaps 10 percent of the lubrications required with present materials. This means a large saving in servicing and maintenance expense while some saving in lubricant cost also can be expected owing to decrease in the likelihood of over-lubrication.

Although in use Hypermatic is always under pressure and flows readily through the lubricant channels, when spread in a thin film between the valve seating surfaces it resists displacement and thus is less likely to flow into the line at the time of lubrication than incompressible lubricants. By the same token, it is claimed to be particularly effective in stopping leakage within the valve. And because leakage involves a pressure drop along the leakage path, pressure of the lubricant can be less than line pressure to accomplish a seal.

To start the use of Hypermatic it is not necessary to remove the old lubricant, which gradually will be displaced. Automatic lubrication is said to be effective at all pressures (including vacuum) for which plug type valves are suitable. Because of its compressibility, from 50 to 100 percent more Hypermatic by volume can be introduced into a valve than present lubricants, as indicated by the quantities in the graduates shown in the view above.

Nordstrom Valve Div., Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa.

SMOKE CONSUMER:

Over-Fire Jet

To facilitate smoke control in boiler furnaces, the Eclipse Fuel Engineering Co. has developed an over-fire air jet system employing a centrifugal pressure blower as the source of air supply. When smoke is being produced it means that insufficient air is present

in the firebox to burn hydrocarbon vapors completely. By forcing air jets into the firebox above the flame, turbulence is created and combustion improved. Controls can be manual or automatic. If the latter is selected, a photoelectric cell is installed in the stack to start the blower automatically if the smoke density goes too high.

Eclipse Fuel Engineering Co., Rockford, Ill.

NON-CLOGGING:

Unusual Spray Nozzle

A unique spiral design, producing finer atomization, has been incorporated in a new line of nozzles for flow rates from ¼ to 100 gpm. This new Bete nozzle shears a continuous film of liquid from a single high velocity jet so that it readily breaks up into uniformly fine particles at fairly low pressure. Vanes or whirling disks are not required. The principle can be adapted to various spray patterns.

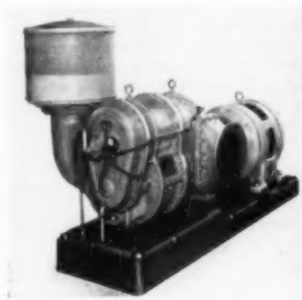
The Bete Fog Nozzle Co., Greenfield, Mass.

LIGHT, DURABLE:

Plastic Drying Trays

Glastic, a Fiberglas-reinforced plastic made with Laminac polyester resin, is used in a newly offered line of chemical and pharmaceutical drying trays. These are light in weight, yet said to be extremely durable and resistant to denting and chipping. Temperatures up to 350 deg. F. have no effect over long periods and most solvents, practically all hydrocarbons, most moderate acids and alkalis, and all salts are without effect. The cost is said to be less than many types currently being used. For identification, color can be incorporated into the resinous material if desired. Several sizes are now produced as standard, while other sizes can be developed at moderate cost.

Laminated Plastics, Inc., 14838 Euclid Ave., Cleveland 12, Ohio.



QUIET OPERATION:

Positive Blower

Quietness of operation, compactness, and greatly reduced weight compared with similar blowers are important features claimed for the new Standardaire blower developed by Standard Stoker Co. Blowers of this type are produced in capacities from 100 to 15,000 cfm., for pressures up to 20 lb. The compression member consists of a pair of rotors of interesting design, one of symmetrical epicycloidal form which mates with a second rotor which acts as a gate. Air is taken in and discharged smoothly from pockets which form between the rotors, with compression developing gradually and without shock within these pockets. The construction is said to make possible lowest possible blower weight for a given capacity, and a lower noise rating.

The blower operates at motor speed and thus requires no gearing other than the timing gears between the rotors. Larger blowers of the line, operating at efficient pressure-speed ratios, are able to develop over-all adiabatic efficiencies around 80 percent or slightly better.

The Standard Stoker Co., 370 Lexington Ave., New York 17, N. Y.

Marshall and Stevens Indexes of Comparative Equipment Costs

(1926 = 100)

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, *Chemical Engineering*, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see *Chemical Engineering*, Feb. 1949, p. 129.

Industry	Sept. 1948	June 1949	Sept. 1949
Average of all......	166.5	160.6	159.6
Process Industries			
Cement mfg.	160.5	155.9	155.9
Chemical	168.5	163.9	163.4
Clay products.......	155.5	150.9	150.4
Glass mfg.	158.6	154.0	153.5
Paint mfg.	161.8	157.2	156.7
Paper mfg.	162.1	157.5	157.0
Petroleum ind.	164.9	160.3	159.8
Rubber ind.	167.3	162.7	162.2
Process ind. avg....	165.9	161.4	160.4
Related Industries			
Elec. power equip...	170.1	165.5	165.0
Mining, milling	169.2	164.6	164.1
Refrigerating	181.5	174.8	173.9
Steam power	157.2	152.6	152.1

CONSTANT VOLUME:

Flow Regulator

A new principle in constant volume flow regulation under varying pressure is incorporated in the recently announced Kates regulator. The device has only a single moving part and is said to hold any preset flow volume constant while the pressure upstream may vary over a range of 100 psig.

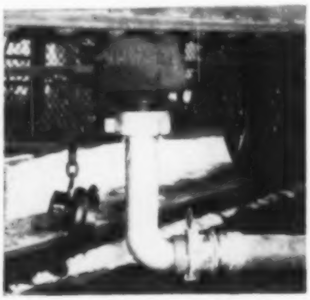
The regulating unit is contained in a vertical cylindrical case having in the upper portion a valve seat and disk, the opening of which is adjusted by a threaded valve stem calibrated linearly in gallons per minute flowing. Concentric with this valve is a differential pressure orifice and movable disk, coupled directly to a high-pressure valve in the lower part of the regulator. This combination produces a constant differential pressure and hence a constant flow which, however, can be regulated by varying the opening of the main valve. The only moving part of the entire regulator is the movable disk in the orifice and the high-pressure valve connected to it. This rigid assembly floats vertically,

(Continued)

without restraint, except for the balancing forces of fluid pressure differential and gravity.

The regulator can be installed without special tools and is suitable for a wide variety of applications, including fuel lines, blending, backwash and rinse control, and a variety of chemical plant problems. Both large and small sizes are available.

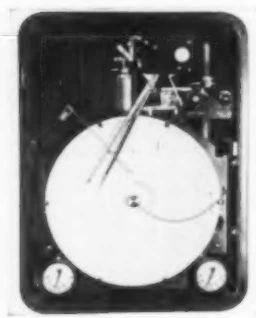
The W. A. Kates Co., Deerfield, Ill.



CAR UNLOADING FITTING

Weighing under 10 lb., this cast aluminum unloading fitting for universal tank car use is said to ease handling and speed hook-up. Connection requires less than 1 min.

The fitting can be provided with various rapid couplings, and in other cast metals than aluminum. *Mead Cornell & Co., P. O. Box 2682, Cleveland 7, Ohio.*

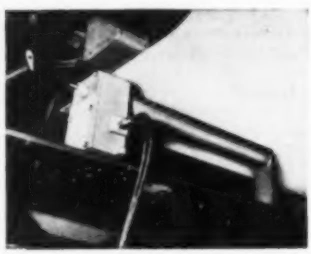


TRANSMIT OR CONTROL:

Pneumatic Instruments

Series A-88 covers a new line of pneumatic instruments for transmitting and controlling flow, pressure, liquid level, and specific gravity, just announced by American Meter. The designs are said to incorporate numerous features developed in cooperation with user instrument engineers, among others, maintenance and service simplifications resulting from reducing the number of pivot points and moving parts to a minimum. Parts are standardized and sub-assemblies unitized, with a high degree of interchangeability. Thus the new instruments are readily convertible to changing conditions and applications. These instruments use a relay which includes a damping device for smooth operation, equipped with a self-cleaning primary orifice and a bypass to permit ready change to automatic control. Reversing of the instruments is easily accomplished by shifting one end of one link, without disturbing other adjustments. A proportional reset controller-receiver, with recording, is shown in the accompanying view.

American Meter Co., 60 East 42nd St., New York 17, N. Y.



USES BETA RADIATION:

Thickness Gage

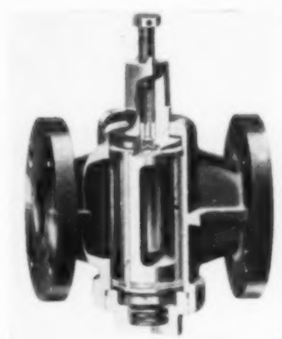
Beta radiation from strontium-90 produced at Oak Ridge is being used in combination with a radiation detector for measuring continuously moving sheet materials without physical contact. Two models, designated as SM-2 and SM-3, are now being produced by Tracerlab. The sheet material to be measured is interposed between the source and the detector and a part of the radiation is absorbed by the sheet, in proportion to its weight per unit area. This weight per unit area, or the thickness, is then read on a properly calibrated recorder connected to the detector. For all practical purposes, chemical composition of the sheet being measured does not affect the calibration of the instrument. Thus, it is comparable to a balance which measures weight without regard to composition.

So far, instruments of this type have been used on condenser paper as thin as 0.0002 in., on metal sheets and foils, on coated textiles and plastic films, and on rubber sheets up to 3/16 in. thick. Inherent accuracy is $\pm$ 0.05 percent of sample thickness, or $\pm$ 0.03 mg. per sq.cm., whichever is larger. The first model mentioned, a heavy-duty type, employs a continuous recorder, while the lighter duty second model indicates thickness on an indicating meter.

Tracerlab, Inc., 130 High St., Boston 10, Mass.

ALLOY FILTER CLOTH

Roebling is now offering Hastelloy B and C filter cloths for exceptional corrosion resistance. Nearly all acids and oxidizing agents can be handled over a wide range of temperature and concentration. *John A. Roebling's Sons Co., Trenton 2, N. J.*



COMPENSATES WEAR:

Lubricated Plug Valve

Known as the Homestead-Reiser Self-Seald valve, a new lubricated plug cock designed to give automatic compensation for wear has recently been introduced. The plug is cylindrical, rather than tapered, and is cut diagonally so as to give a wedging action which not only adjusts the plug for wear, but keeps the sealing surfaces of plug and body in intimate contact at all times. This is said to provide an extra tight seal against leakage, and lower lubricant losses. The design is such that line fluid pressure acts on the plug to promote the sealing effect.

In this valve the port areas are equal to the area of standard pipe. A complete lubricant seal is maintained

(Continued)

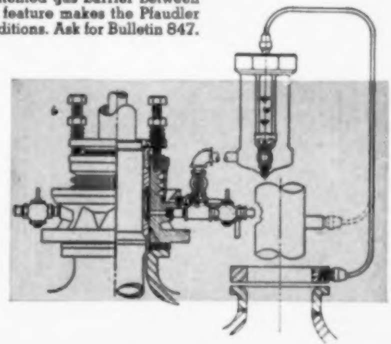
PFAUDLER GLASS-LINED PUMP Designed for services beyond the chemical resistance offered by alloys; suitable for temperature and pressure conditions outside the range of other types of linings; facilitates the handling of materials which do not adhere to glass but do adhere to metal; combines high acid resistance with mechanical ruggedness.

The Pfaudler Pump operates in a vertical position to allow separation of liquid pumped from the stuffing box. It is designed for low speed operation and will handle from 30 to 240 GPM. Equipped with stuffing box for severe chemical service with a patented gas barrier between liquid pumped and the stuffing box. This feature makes the Pfaudler Pump practical for most severe service conditions. Ask for Bulletin 847.

5 New PFAUDLER DEVELOPMENTS

TO CHECK CORROSION AND IMPROVE OPERATING PERFORMANCE!

Here are five new Pfaudler developments which increase the service life and improve operating control of glass-lined equipment used for highly corrosive services. Complete details on request.

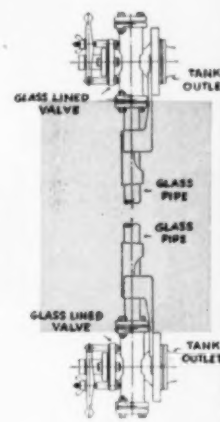


AUTOMATIC COUNTERBALANCE LUBRICATION SYSTEM Pfaudler Stuffing Boxes must withstand the most severe chemical corrosive conditions. Automatic counterbalance keeps the Stuffing Box flooded with lubricant under slightly higher pressure than the reactor, which excludes all corrosive vapors. Several methods depending on the operating conditions are available. Also, see "Teflon" Packings and ask for Bulletin.

PFAUDLER "TEFLON" PACKING Pfaudler has developed tough porous "Teflon" packing rings without any binding material. These provide complete chemical resistance and are recommended only for the bottom rings of the stuffing box where they act as an effective stop for the standard packing. Combined with automatic lubrication this frees the stuffing box from most maintenance problems.

PFAUDLER MULTIPLE INLET AND SIGHT BOX ASSEMBLY This glass-lined inlet assembly increases the flexibility of any Pfaudler reactor, old or new. It is made for 2", 3" and 4" ASME flanged openings and can be assembled to take a maximum of four inlet lines as shown. The sight box permits visual observation of rate of flow and prevents leakage of valves. All inlet paths are completely drained without possibility of trapped liquid. Details on request.

PFAUDLER GAUGE GLASS ASSEMBLY This assembly is a metal free gauge glass for highly corrosive acid conditions. Special Pfaudler glass-lined fittings include quick acting porcelain shut-off valves and standard 1" glass tubing with "Teflon" packings.



SEE THESE NEW DEVELOPMENTS AND OTHERS AT

Pfaudler

THE PFAUDLER CO., ROCHESTER 3, N.Y.

ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT

Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

THE CHEMICAL INDUSTRIES EXPOSITION

Week of November 28, 1949

Booths 72 and 73

around the ports and the valve is provided with visible stops to limit operation to a quarter turn.

Homestead Valve Mfg. Co., Coraopolis, Pa.

NEW MECHANICAL PRINCIPLE:
Roller Press

Installation at the Armour Research Foundation of a new roller type hydraulic press known as the Stacomizer has recently been completed. This is a research model which will be available for industrial experimentation and is expected to lead to the development of commercial installations. The manufacturer has also completed a single industrial size unit which will be employed in a Canadian newsprint mill for dehydrating and preparing bark for use as fuel and for exploring other pulp and paper industry uses.

The machine consists essentially of two rolls, a work roll and a back-up roll, between which a free-floating ring surrounding the work roll is nipped. Power to drive the assembly is applied to the back-up roll, which turns in a fixed position. The work roll is also driven, but is permitted to move in a fixed horizontal plane. The floating ring revolves freely between the rolls which are under hydraulic pressure that can be regulated up to 500 tons. This ring is the same width as the rolls, but about twice their diameter. Material to be processed is fed into the lower part of the floating ring and is carried upward into the horn angle area formed by the outside surface of the work roll and the inside surface of the floating ring.

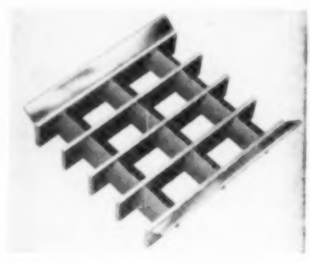
Movability of the work roll enables the material being treated to form a sheet between ring and work roll, which is under extremely high pressure without shear or grinding action. Any fluids expressed by this pressure flow by gravity from the bottom of the floating ring for collection, while remaining materials are removed by scrapers and conveyors.

The new machine is expected to prove useful in extracting a wide variety of oils, juices, and other liquids from solid materials. Recovery of fibers from various plants and the milling of powdered or granulated materials are other possibilities. Little heat is generated owing to elimination of shear and grinding, thus preventing the heat deterioration of heat sensitive materials.

Stacom Industries, Inc., 29-28 41st Ave., Long Island City 1, N. Y.

PUSHBUTTON MIXER

Air cylinders and solenoid air valves now enable the standard fertilizer mixers produced by Worthington-Ransome to be provided with push-button control of charging gate and discharge chute. This speeds up operation and materially reduces manual effort. *Worthington Pump & Machinery Corp., Worthington-Ransome Industrial Mixer Section, Dunellen, N. J.*



PROTECTS EQUIPMENT:
Grate Type Separator

Sizes ranging upward from 8 in. square are available in a new line of permanent magnetic separators produced in grate form for protecting the feed openings of various kinds of processing equipment. The grate consists of a grouping of magnetized Alnico bars, with iron spacers. Angular side supports are designed so that the grate can be laid in the bottom of a hopper or floor opening, being readily lifted out for cleaning. Customarily a wire grid (not shown) is installed over the grate, with rods spaced midway between the magnetic bars to

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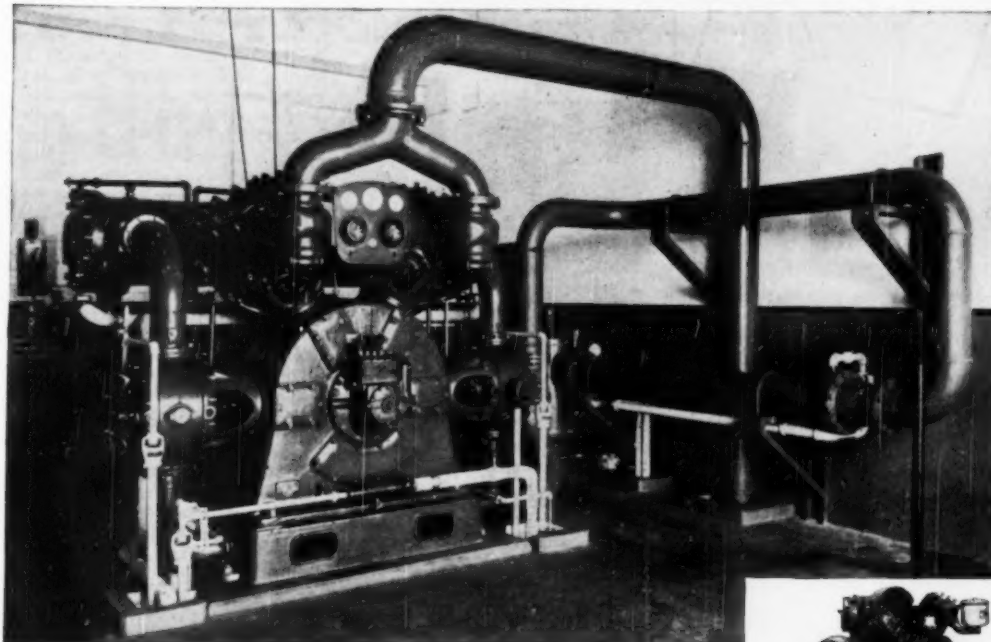
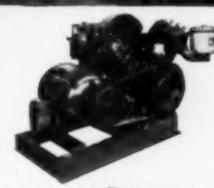
High Air Capacity . . . Unmatched in

LOW AIR COST



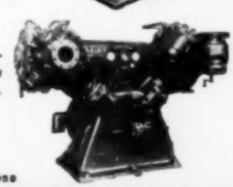
JOY WN-114 COMPRESSOR

The JOY WN-114 is a four-cylinder, two-stage, double-acting compressor producing 1092 to 3656 CFM in single units, and up to 7312 CFM in twin units, depending on pressure. Exclusive "Dual-Cushion" valves provide top efficiency in low-cost air power. ● JOY builds the most modern compressors available for either centralized or decentralized air supply—*write for Bulletins.*



The JOY WL-80, in 9 sizes from 81 to 590 CFM.

The JOY WG-9, in 11 sizes from 153 to 822 CFM.



The JOY WN-112, in sizes from 378 to 1828 CFM.

Consult a Joy Engineer

W&D 12059

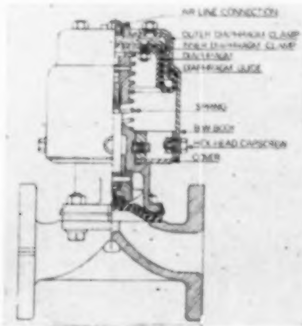
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

deflect the material and cause streams to wipe the bars. This device not only holds tramp iron and other magnetic particles, but also catches non-magnetic materials sufficiently large to be intercepted.

The Bauer Bros. Co., 1726 Sheridan Ave., Springfield, Ohio.



FOR AUTOMATIC OPERATION:
Valve Actuator

Grinnell-Saunders diaphragm valves can now be provided with a lightweight, compact and leak-proof actuator for either pneumatic or hydraulic operation. The new actuator is a Grinnell application of the Bendix-Westinghouse Rotochamber principle, whereby the use of a rolling sleeve seal permits the elimination of sliding seals or stuffing boxes and does away with sealing and lubrication troubles. It practically eliminates friction. Tests up to 7,000,000 strokes have shown the actuator to have long life and to be free of trouble. Protection against excessive closing pressure is provided by an adjustable positive stop.

Although pressures up to 105 psi. may be used, ordinarily only 50 psi. of actuating pressure is necessary to close the valve against 100 psi. line pressure. Actuators may be positive-acting, negative-acting or double-acting, and are available for valves from ½ to 6 in. in size.

Grinnell Co., Inc., Providence 1, R. I.

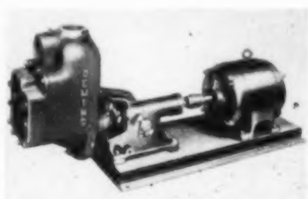
ANY SPEED:
Variable Speed Drive

A novel idea in variable speed drives which gives an infinite speed range down to and including zero speed, with constant torque, is being offered under the designation of Specon ED. This drive makes use of a unique motor-generator combination. It consists of a standard a.c. squirrel-cage motor (or other constant-speed prime mover), two d.c. motors, and a differential gear box. The constant-speed motor or prime mover is coupled with the two d.c. motors through the differential gear box. The d.c. motors are connected in a closed circuit and require no outside source of power.

In operation, the d.c. motors run at varying controlled speeds within a 3:1 range and are the means of controlling the torque and variable speed output shaft. When the output shaft is at its highest speed, one d.c. motor is running at its lowest speed and acting as a generator, supplying power to the other d.c. motor which runs at its maximum speed. The reverse situation holds for the lowest speeds. Since the lowest speeds of the d.c. motors are never below one-third of no load rating, they develop heavy torque at low speed without heating.

Efficiency over the entire range is said to be considerably higher than where speed changes are effected electronically. The device ordinarily uses no electronic tubes and hence no complex electronic control panel. It is said to be particularly suited to processing of web materials requiring constant or decreasing tension between a machine and a winding stand.

Speed Control, Inc., 1420 Depot St., Wickliffe, Ohio.



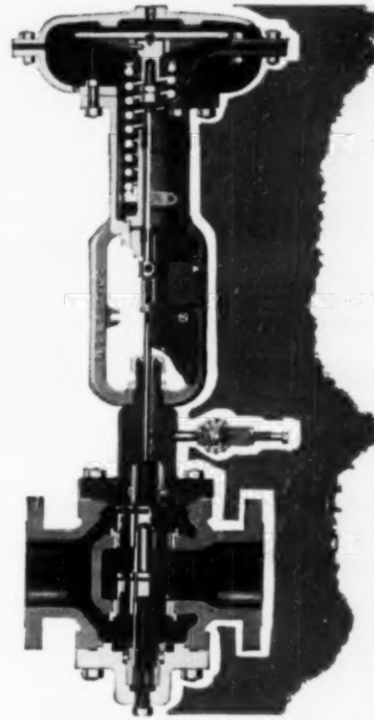
SELF-PRIMING:
Centrifugal Pumps

Six stationary models of a new line of self-priming centrifugal pumps offered by the Deming Co. have been designed to cover a range of capacities from 10 to 300 gpm. against heads up to 250 ft. The line also includes a small portable pump with direct-connected gasoline engine for 10 to 90 gpm. against heads of 80 to 15 ft. The pumps employ a built-in, self-priming arrangement which is said to be rapid, automatic and fool-proof, as well as non-syphoning. The impeller is semi-inclosed and is of the non-clogging type, designed to pass usual size solids encountered in dewatering work. Adjustment can be made for impeller wear. Certain models are designed with the casing and stuffing box separate from, and bolted to, the support head in such a way that the pump can be

(Continued)

YOU GET ALL 3 with the BELFIELD "700"

Diaphragm Control Valve



1 Advanced Design

Such attractions as Premolded Neoprene Diaphragm with Rolling Action . . . Pivot-Mounted Inner Plate and Cradle-Mounted Upper Spring Flange . . . Duplex Bearings for Stem . . . One-Piece Bonnet . . . Top and Bottom-Guided Disc . . . *all in addition to the usual features you expect in a fine valve.*

2 Proved Quality

The kind of quality that provides enduring reliability with a minimum of maintenance . . . the result of more than 100 years of experience with the right design, the right material, the right specification for each and every job.

3 Nationwide Service

Every Belfield Valve is backed by the entire Minneapolis-Honeywell network of branch offices and factory-trained field engineers, as near to you as your phone.

Investigate these complete time and money saving facilities . . . today . . . write for your copy of Bulletin 700-1.

BELFIELD VALVES — WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL — MH

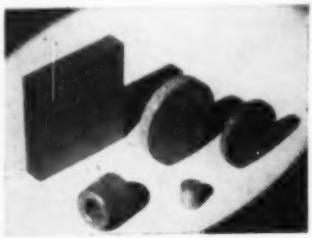
MINNEAPOLIS-HONEYWELL REGULATOR CO.
BELFIELD VALVE DIVISION
PHILADELPHIA 44, PA.

Offices in principal cities of the United States, Canada and throughout the world

MINNEAPOLIS **Honeywell** *Diaphragm Valves* AND PROCESS CONTROL SPECIALTIES **Belfield** VALVES

readily adapted for handling corrosive liquids by making the liquid end parts of special alloys, while the support head is of standard cast-iron construction. Several types can be furnished in all iron, bronze fitted, or all bronze construction.

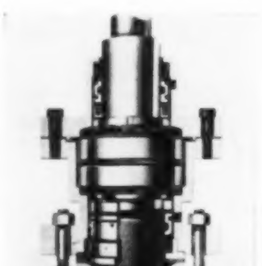
The Deming Co., Salem, Ohio.



WIDE POROSITY RANGE:
Stainless Steel Filters

Oilite stainless steel filters, produced from stainless steel powders by powder metallurgy methods, are now in quantity production for chemical industry use. These filters are produced by a Chrysler division in disks, sheets, plain cylinders and cones and can be made with porosity ranging from nearly zero to more than 60 percent, depending on the application. They are said not to be brittle or friable, and to be efficient for filtering, separating, diffusing, and regulating the flow of a wide variety of liquids and gases. If necessary, special shapes can be built to customers' designs.

Amplex Mfg. Co., Division of Chrysler Corp., Detroit 31, Mich.



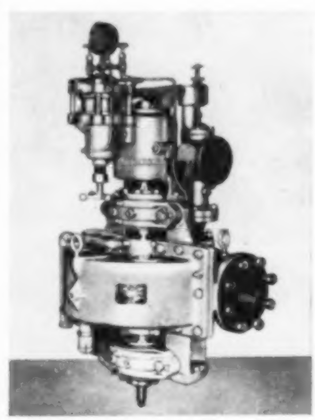
ELIMINATES LEAKAGE:
Agitator Shaft Seal

An improved rotary mechanical seal for shafts is a new Glascote development used on top-entering glass-coated agitators. By eliminating the conventional packed stuffing box, the new seal is said to eliminate leakage and constant repacking, while at the same time it permits the use of higher pressures and eliminates friction and wear between packing and agitator shaft.

As the illustration shows, the unit consists basically of a liquid-tight housing, closed at the top and bottom with rotary seals. The revolving metal seal rings, which are packed to the shaft, are maintained in close contact with stationary carbon gland inserts by the pressure of a number of coil springs. A suitable oil or other cooling lubricant is circulated through the housing under slightly higher pressure than the internal pressure of the vessel. The lower seal, which contains the vessel pressure, is made of a corrosion resisting material suitable for the service. The glass coating at this point is trued by grinding, if necessary, to insure efficient packing, but since the ring and shaft rotate together, the packing is not subjected to wear. The mechanism shown between the seals is a double row of tapered roller bearings carrying and guiding the agitator shaft.

This mechanism, although designed primarily for glass-lined vessels, is equally suitable for stainless steel or other alloy equipment.

Glascote Products, Inc., 20900 St. Clair Ave., Cleveland 17, Ohio.



FOR PUMP DRIVE:
Vertical Turbine

For driving vertical centrifugal pumps and other vertical units requiring horsepower ratings up to 90 b.hp., the Whiton Machine Co. has developed a small vertical steam turbine built of semi-steel, or cast steel, to meet requirements for practically any steam pressure and temperature. The turbine is equipped with both constant

(Continued)

"You'll make better alkyds my way,"

says

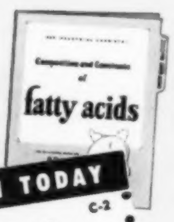
Mr. fatty acid!

Here's a little lesson in logic, says Mr. Fatty Acid. If B is better than A . . . and C is like B but costs less . . . what's your best buy?

Now let's translate that logic to alkyd-manufacture. Soya oils, as you know, are particularly desirable for the manufacture of alkyds. They offer a combination of characteristics possessed by no other oil . . . better color, flexibility, durability, air drying and baking properties. And soya fatty acids are even better than soya oils . . . lighter in color, faster in the kettle because of direct esterification . . . easier to work.

That brings us to ADM's specially developed distilled Soya Fatty Acids. We offer four types: Water White, Regular, RO-10 and RO-4. The latter two are surprisingly economical. Yet they're of unusually high quality.

If you like the reasoning, it points directly to the coupon below. Why not mail it now . . . and be on the way to *finer alkyds at lower cost!*



MAIL THE COUPON TODAY

C-2

ARCHER-DANIELS-MIDLAND CO.
600 ROANOKE BUILDING
Minneapolis 2, Minnesota

Please send material checked on ADM Fatty Acids:

___ Data for making Alkyds
___ Bulletin No. 78 on RO-10 Soybean Fatty Acids
___ Chart No. 77 showing Composition and Constants of Fatty Acids

Name ___ *Position* ___
Company ___
Address ___
City ___ *Zone* ___ *State* ___

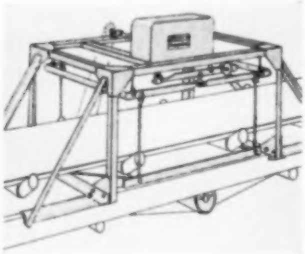
Take the SCIENTIFIC SHORTCUT with

ADM fatty ACIDS

ARCHER-DANIELS-MIDLAND COMPANY
MINNEAPOLIS, MINNESOTA

speed and emergency governors, and is provided with a bolting flange at the lower part of the casing to bolt directly to the flange of the driven unit.

Whiton Machine Co., New London, Conn.



WEIGHS, INTEGRATES:

Conveyor Scale

A unit type belt conveyor scale, assembled and shipped as a complete unit requiring fewer than a dozen bolts for its complete installation, is being offered under the name of Transportometer by the Sintering Machinery Corp. The unit can be installed on any existing horizontal, inclined or declined belt conveyor of any width or speed. It automatically weighs, indicates and totalizes any tonnage up to 2,000 tons per hour. It can be used for automatic control of feed conveyors or other feeding devices and may be equipped with remote recording or totalizing equipment.

Sintering Machinery Corp., Transportometer Division, 60 Wall Tower, New York 5, N. Y.

EASY CLEANING:

Horizontal Plate Filter

For applications involving a large volume of filtrate and frequent cleaning of the filter plates during the production run, the Sparkler Manufac-

(Continued)

turing Co. has developed a new horizontal plate filter which emphasizes easy cleaning without removing the filter plates. The filter is a vertical cylinder containing horizontal plates, and equipped with a side panel which can be opened to expose all plates. Through this opening the filter cake can be washed off completely and quickly. The operation is said to take only one or two minutes. At the end of the filter cycle all plates can be removed at one time through the top of the filter to facilitate insertion of fresh filter paper or cloth. A wide range of construction materials and linings can be provided, and filter capacities may range from 60 to as high as 60,000 gph.

Sparkler Mfg. Co., Mundelein, Ill.

LIGHTWEIGHT:

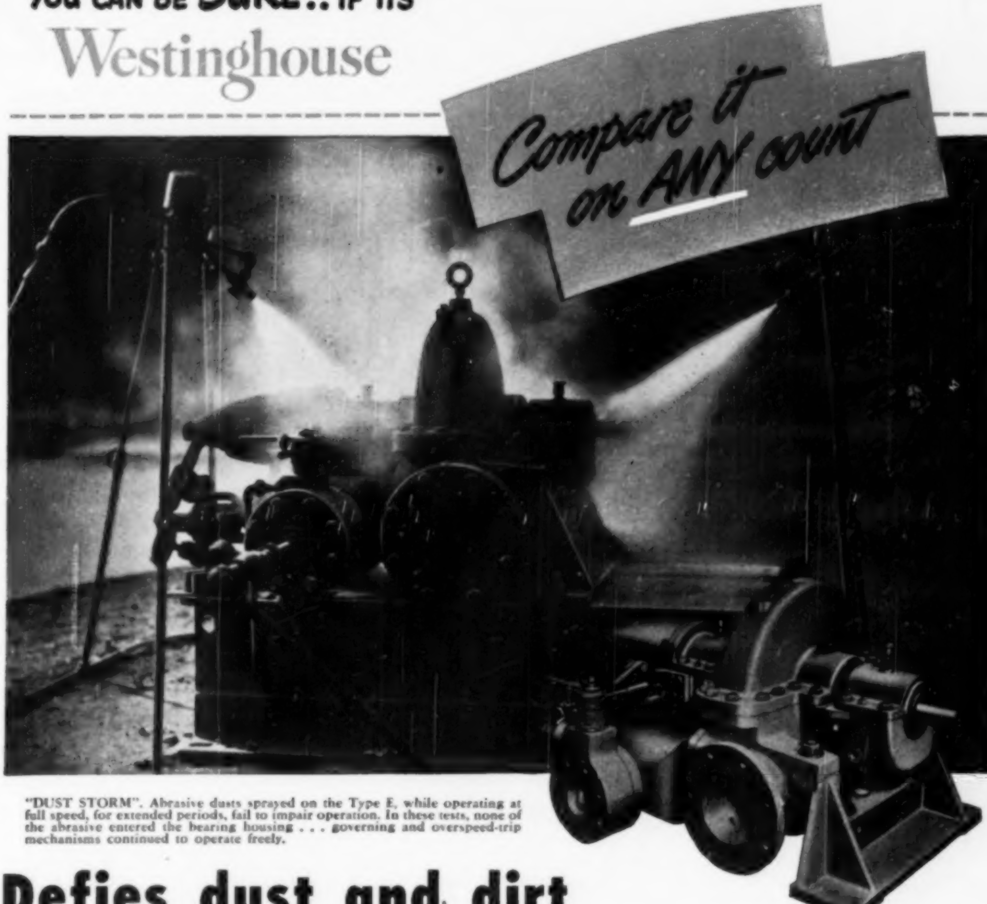
Dry Chemical Extinguisher

More efficient expulsion of the extinguishing agent, lighter weight, and unusual compactness are claimed for the new Quick Aid dry chemical extinguisher offered by General Detroit Corp. and its West Coast affiliate, General Pacific Corp. This extinguisher expels a fine white powder onto the blaze which releases carbon dioxide and smothers the fire. The powder is expelled by carbon dioxide contained in a small cylinder inside the main extinguisher shell. To start the extinguisher, the operator punctures the cylinder by squeezing a valve mounted on top of the extinguisher. A second valve on the hose controls the flow of extinguishing agent. Improvements in funneling the powder directly into the outlet are said to increase operating efficiency as much as 10 percent, while the use of an extremely lightweight shell of hardened and drawn brass reduces the extinguisher weight and facilitates its use.

(*Continued*)

YOU CAN BE SURE.. IF IT'S

Westinghouse



"DUST STORM". Abrasive dusts sprayed on the Type E, while operating at full speed, for extended periods, fail to impair operation. In these tests, none of the abrasive entered the bearing housing . . . governing and overspeed-trip mechanisms continued to operate freely.

Defies dust and dirt

Depend on the general-purpose Type E Turbine for the kind of service you want . . . whenever and wherever you want it.

Prolonged exposure to abrasive dusts fails to more than dirty up the outside casing. Type F construction keeps foreign matter out, and eliminates close-sliding fits. Materials used in construction resist corrosion and erosion . . . you get a turbine that's *rugged.*

Investigate these, and all the other vital features wrapped up in industry's *standard* turbine . . . the Type E. Get complete information from your nearby Westinghouse office, or write for your copy of the Type E Turbine Book, B-3896. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

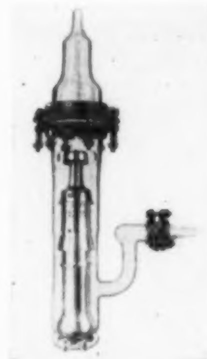
J-50500-A

Westinghouse
TYPE E
Turbines

NEW EQUIPMENT, *cont. . .*

The extinguisher has been approved by Underwriters' Laboratories.

The General Detroit Corp., Detroit, Mich.

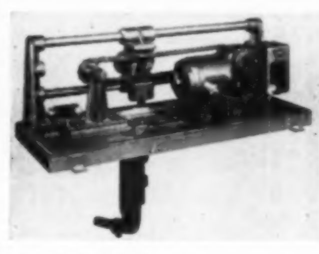


HIGH PERFORMANCE:

Diffusion Pump

Pumping speeds up to 67 liters per second, and attainable vacuum of 4×10^{-7} mm. Hg, are claimed for a new glass-barrel high vacuum oil diffusion pump developed by Eitel-McCullough, Inc. The pump has a three-stage metal diffusion unit. It requires no liquid cooling and no charcoal trap. Designated as Type HV-1, it has standard flanged glass pipe fittings.

Eitel-McCullough, Inc., San Bruno, Calif.

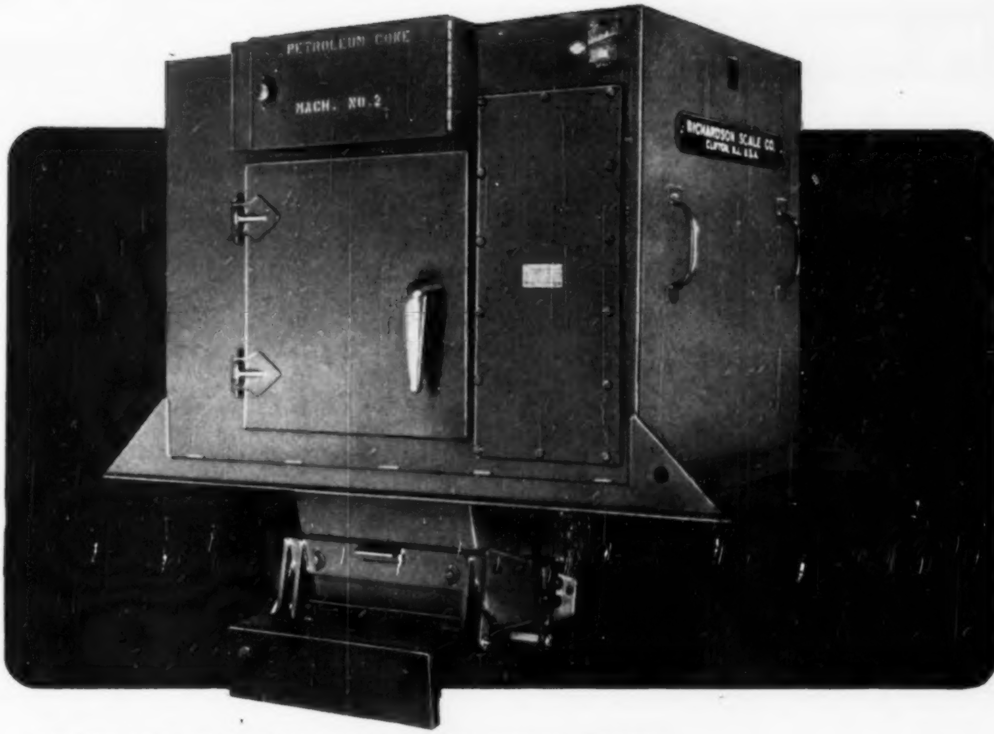


ACCURATE, RUGGED:

Automatic Sampler

Manufacturing and sales rights to an automatic sampler which is said to feature accuracy and ruggedness, have been secured by the Hardinge Co. The new sampler, now on the market, takes periodic cuts from a stream of moving material, either wet or dry, at any stage in a continuous process. The unit is entirely automatic and can be set to operate at any time interval from 5 to 60 minutes. When activated by a time switch, the sample cutter moves horizontally at a constant speed

(Continued)



ACCURATE PROPORTIONING AT HIGH SPEED . . .
WITH THE ALL-ELECTRIC RICHARDSON BULK SCALES

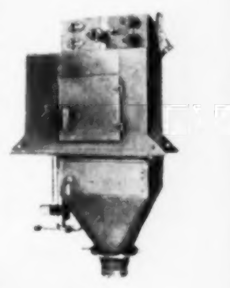
Eliminate hidden losses in weighing, proportioning, and blending . . . maintain *exact* control over your mixes . . . with a battery of the NEW, all-electric E-50 Richardson AUTOMATIC BULK WEIGHING SCALES.*

Whatever you're batching, whether it's baby powder or an Asbestos shingle mix, you'll have accurate control over the proportions of each ingredient. Result; a uniform end product. Here's why:

- *Different materials are weighed in any desired proportion with perfect coordination of discharge.*
- *Discharge on a time schedule, pre-set for each material.*
- *Accuracy of each weighing* proved *by sensitive indicator.*
- *Proportioning automatically stops if any scale runs out of material.*

The smooth, all-electric operation of the E-50 speeds up the processing cycle. Scales can be set to function simultaneously, singly, or in groups. Completely dustproof housing; electric controls separately encased, supplied for Class 2-Group G or Class 1-Group D hazardous locations.

AND WHEN YOU BAG CHEMICALS . . .



You'll need the all-electric E-50 AUTOMATIC *BAGGING* SCALE for fast, accurate net weighing of practically all materials packaged in open-mouth paper or textile bags. Still faster is the E-50 DUPLEX BAGGER. Actually 2 E-50's combined, with bifurcated top hopper and common bagging hopper, bag holder and motor drive. It will double output with just one operator and without sacrificing the accuracy of a single scale at a more conservative speed.

Normal Range:—5 lbs. to 25 lbs. and 25 lbs. to 50 lbs. Other models are available for greater capacities.

5894

See the new, exceptionally fast E-50 bulk scale in action at the Exposition of Chemical Industries in Grand Central Palace, New York City, Nov. 28 to Dec. 3 inclusive — Booth Nos. 659-660.

RICHARDSON SCALE COMPANY
CLIFTON, N. J.

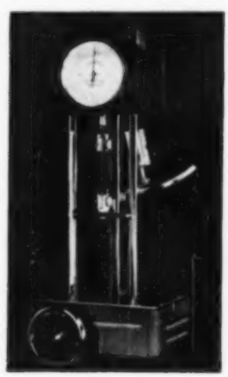
Atlanta • Boston • Buffalo
Chicago • Minneapolis • Wichita
New York • Omaha • Philadelphia
Pittsburgh • San Francisco
Montreal • Toronto

across the stream of moving material, diverting a representative sample into a sampling launder or container. Cutter movement is uniform as to stroke, speed and length during each cutting operation.

The Hardinge Co., York, Pa.

ELECTRONIC VULCANIZER

It may not be long, according to Goodrich, before rubber goods such as this can be produced from mixing mill to box car in 20 min.! This vulcanizer, operating electronically, has produced over 9,000,000 ft. of red syringe tubing in 18 months at Plant No. 4 of the Goodrich Co. It has been developed and patented by the company. *The B. F. Goodrich Co., Akron, Ohio.*

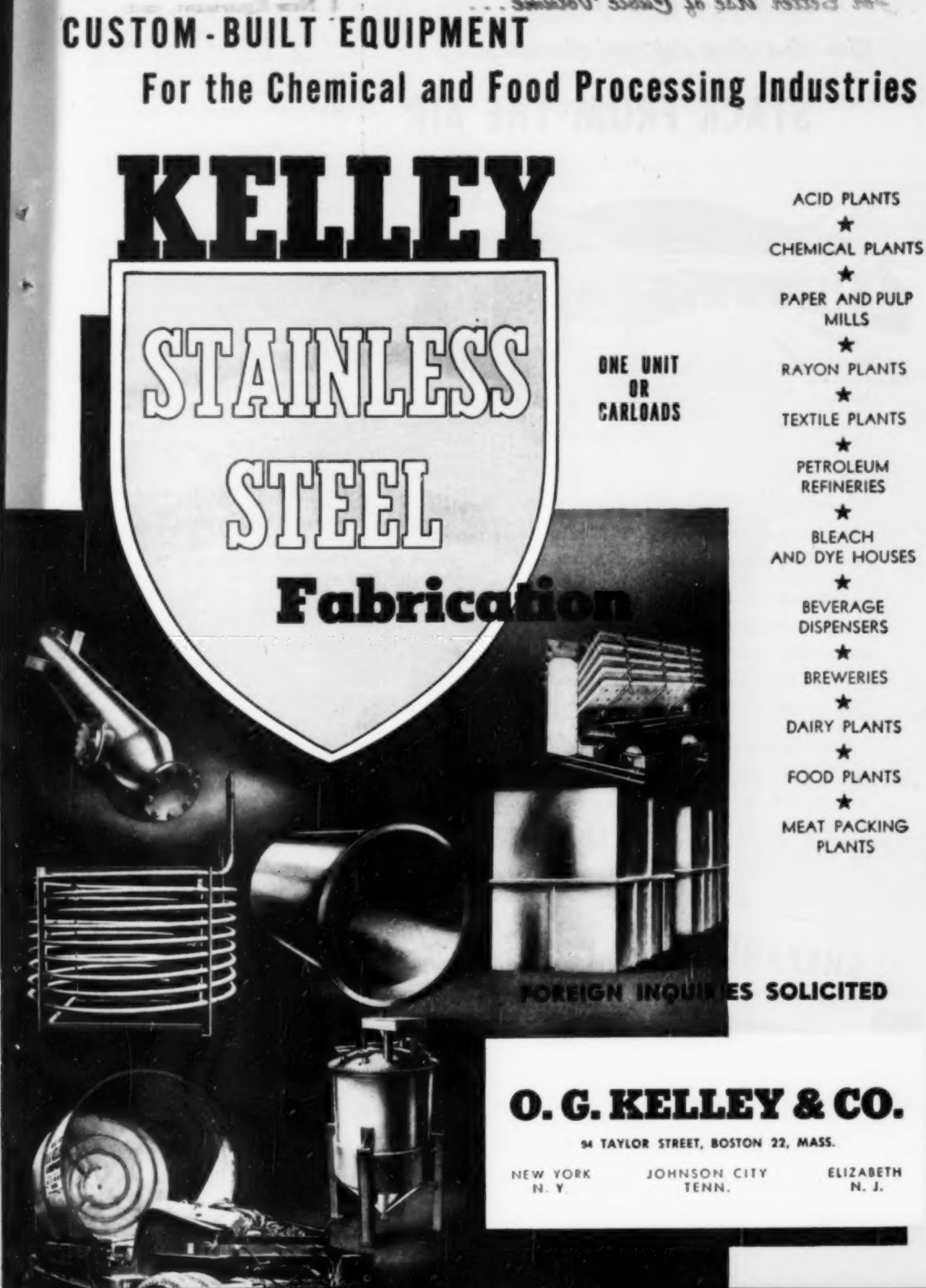


LOW COST:

Stress Tester

To enable every plant that requires low-range testing to be able to afford a machine for this purpose, W. C. Dillon & Co. has developed a low cost hand-operated instrument with a range of 0 to 100 lb. over all, and with scales for 0 to 10, 0 to 20, 0 to 50 and 0 to 100 lb. The machine is universal in application, handling specimens under tensile, compression, transverse

(Continued)


CUSTOM-BUILT EQUIPMENT
For the Chemical and Food Processing Industries
KELLEY
STAINLESS
STEEL
Fabrication
ONE UNIT
OR
CARLOADS
ACID PLANTS
CHEMICAL PLANTS
PAPER AND PULP MILLS
RAYON PLANTS
TEXTILE PLANTS
PETROLEUM REFINERIES
BLEACH AND DYE HOUSES
BEVERAGE DISPENSERS
BREWERIES
DAIRY PLANTS
FOOD PLANTS
MEAT PACKING PLANTS
FOREIGN INQUIRIES SOLICITED
O. G. KELLEY & CO.
94 TAYLOR STREET, BOSTON 22, MASS.
NEW YORK N. Y.
JOHNSON CITY TENN.
ELIZABETH N. J.

and shear stresses. It is hand-operated through a worm-and-gear drive, with provision for later motorization at any time. Calibration can be in decimals of a pound, ounces or kilograms. A variety of grips is available for different kinds of specimens.

W. C. Dillon & Co., 5410 West Harrison St., Chicago 44, Ill.

Briefs . . .

SAFETY FEATURE. The Type VVH pressure-vacuum vent valve previously described in these pages is now available with a flame arrestor bank to prevent propagation of flame into storage tanks containing volatile liquids. The danger of fire is greatest when the tank is venting and releasing volatile vapors into the atmosphere. With the flame arrestor bank, any flame resulting from a flash of lightning or from fire nearby is prevented from flashing back into the tank. The arrestor bank, of rolled aluminum construction, can be removed readily for cleaning. *Black, Sivalls & Bryson, Inc., 720 Delaware, Kansas City 6, Mo.*

DURIMET 20 SHEET. Durimet 20 is now available for the first time in sheet and plate. This alloy, suitable for corrosive applications which ordinary stainless steels cannot withstand, has previously been available in castings, bar, strip and tubing. It is now being produced for stock in gages of 24 to 11 and plate thicknesses from 25 ga. to $\frac{3}{8}$ in. *The Duriron Co., Dayton 1, Ohio.*

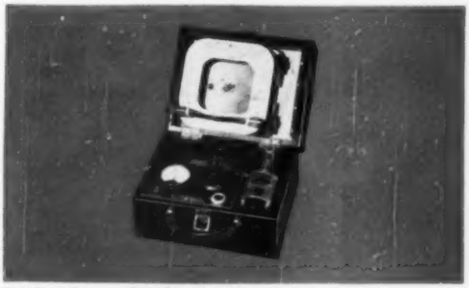
DE-I IMPROVEMENT. Recent research by Resinous Products has shown that a judicious mixture of several of its Amberlite resin exchangers in water de-ionization units makes it possible to obtain a wide range of capacities within a fixed bed volume. This means that ion exchange unit manufacturers can employ a smaller number of vessel diameters and heights, which should result in cost savings. This mixing of different exchangers is found not to produce any increase in attrition, nor does it appreciably change hydraulic characteristics of the unit. *The Resinous Products Division, Rohm & Haas Co., West Washington Square, Philadelphia, Pa.*

STRONG ACID VALVE. Handling of 66-deg. Baumé sulphuric acid can be accomplished with a new plastic diaphragm available for the Hills-McCanna Saunders type diaphragm valve. These diaphragms are built for sizes from $\frac{1}{2}$ to 4 in., with a

(*Continued*)

HERE'S HELP FOR YOUR TESTING AND MEASURING PROBLEMS

Use one of these 3 instruments...or select from more than 300 other G-E stock instruments



To Cut Costs of Balancing Rotors

—use the G-E portable dynamic balancer

By using the G-E portable dynamic balancer to balance rotors in their own bearings, you can drastically reduce the time and cost of balancing rotors in generators, motors, and in other machines. One operator alone can balance two-bearing machines, and he needs to make only three runs.

Ideal for factory-testing, you can use the device for installation or maintenance work, and for field service on any rotor within a speed range of 600 to 6000 rpm and weighing more than 30 pounds. Write for GEA-320.

To Detect Insulation and Winding Faults Quickly

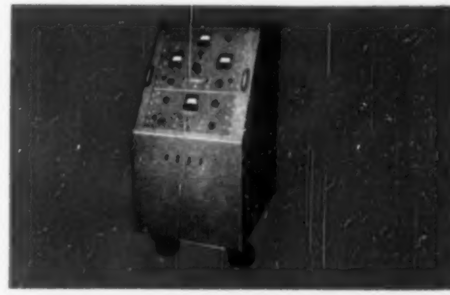
—use the G-E winding-insulation tester

You can speed up production-line testing of motors, transformers, and generators by using the G-E winding-insulation tester. At one G-E plant, for example, more than 4000 motors a week are tested with one device.

Less than one minute is required for a complete test, which includes resistance, impedance, turn-balance, and complete high-potential tests. The operator can determine the nature of the defects by the wave shapes of the oscillograms. Write for GEC-321.

GENERAL ELECTRIC

You may find that General Electric engineers can help you by recommending one of the many G-E stock devices and instruments. Your problem, especially if it is one common to industry, may even justify developing new equipment. Send the coupon today to Apparatus Department, General Electric Company, Schenectady, N. Y.



To Locate Leaks in Closed Systems

—use the G-E Type M Leak Detector

By locating even the smallest leaks while your products are on the production line, you reduce operating costs, cut service expense in the field—and safeguard the good will of your customers. Used in G-E refrigerator production for more than two years, the Type M detector uses helium as a tracer. The detector is so sensitive that it can detect one part of helium in 200,000 parts of air. Write for GEC-336.

FOR HELP on your Testing Problems . . .
Mail this coupon today to:

General Electric Company
Section E687-16
Schenectady 5, N. Y.

Please send me descriptive information on instruments that will help me to test ....

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Name ....

Company ....

Title .... Street ....

City .... State ....

choice of cast iron, cast steel, Durimet or glass-lined bodies. All sizes are produced for pressures to 100 psi. and temperatures to 125 deg. F. *The Hills-McCanna Co., 3025 North Western Ave., Chicago 18, Ill.*

ELECTROSTATIC SAMPLER. Mine Safety is now offering a new electrostatic sampler for airborne dusts, fumes and smokes. The device is equipped with a portable sampling head and a specially designed power pack, together with a high-voltage indicator. Determinations can be made by weight without removing the sample from the tube, or the sample may be removed for other methods of quantitative or qualitative analysis. *Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa.*

FAST ELECTRODE. A new Eutectic electrode known as the Eutec-Hand-Omatic is an a.c.-d.c., no-gap electrode which is merely pressed against the metal and drawn straight along, like a pencil, without any back or forth weaving motion. This is said to yield a perfect weld automatically since there is no arc gap maintained and operation is easy. The new electrode is said to work with all mild steels and low alloys, as well as high-tensile steels. No special equipment is needed. *Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.*

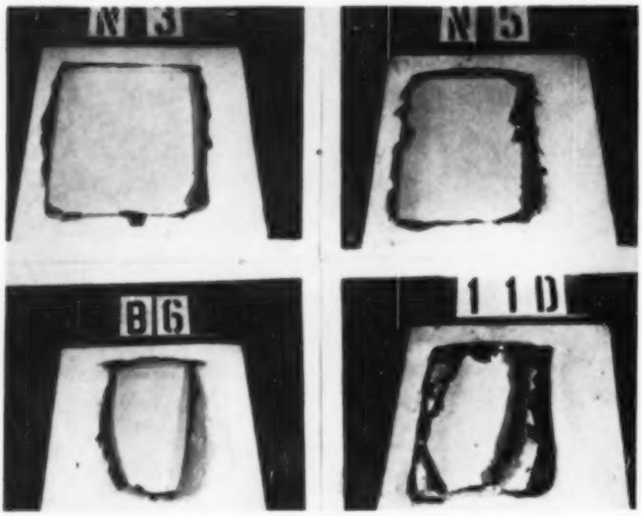
VALVE MOTOR. Gate valves may now be operated by a simplified fluid-motor operator of Crane design. The motor unit comprises motor, gear box and yoke, and is bolted to the valve bonnet. The motor derives its power from five flexible diaphragms mounted radially about an eccentric on the drive shaft. Operating fluids may be liquids or gases under pressures from 40 to 300 psi. These valve motors are suitable for valve sizes from 4 to 30 in. *The Crane Co., 836 South Michigan Ave., Chicago 5, Ill.*

CAR SHAKER. Link-Belt has augmented its present line of car unloaders with a shaker for hopper-bottom gondola cars. The shaker, normally suspended from a hoist, is readily lowered to the top of the car, employing rotation of a vibrator shaft to impart heavy hammer-like blows to the car. However, operation is said to be relatively quiet, with unloading speeds of eight to ten cars per hour under proper circumstances. *Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.*

—End

New Products and Materials

JOSEPH A. O'CONNOR, Assistant Editor



Coatings Make Doped Fabric More Fire-Retardant

The National Bureau of Standards has developed fire-retardant coatings for fabric-covered aircraft that effectively double the time interval between ignition of the fabric and its destruction by fire.

Wind-tunnel burning tests were conducted on doped fabric panels treated with the experimental coatings. The burning tests were carried out at the Indianapolis Experimental Station of the Civil Aeronautics Administration. A panel treated only with the highly flammable cellulose nitrate dope was destroyed in 2 sec. (above, top left). It took 4 sec. to destroy a panel coated with cellulose nitrate dope plus four coats of a fire-retardant mixture (above, top right). Destruction time for a panel coated with the less flammable cellulose acetate butyrate dope but with no fire-retardant coating was 6 sec. (above, bottom left). When the panel coated with cellulose acetate butyrate dope got in addition four coats of the same fire-retardant mixture, however, it took 12 sec. to consume it (above, bottom right).

The highly flammable cellulose nitrate dope used on airplane fabrics has been responsible for much loss of life and property by fire. Although dopes based on other cellulose derivatives, such as ethyl cellulose, cellulose acetate and cellulose acetate butyrate, are much more difficult to ignite and have a much lower flame velocity, even though they are unsatisfactory in a power plant fire, in which flame from burning gasoline or oil may be in continuous contact with doped fabric for several seconds. Yet no fire-retardant film-forming materials are known that tauten airplane fabrics as effectively and as permanently as do the dopes based on the cellulose derivatives. Unfortunately, the addition of resins or other fire-retardant substances to these compounds lessens their capacity to tauten. Efforts were therefore directed toward the development of highly efficient fire-retardant coatings to be applied to the surface after it is already doped. In designing the coatings, the peculiar requirements of aircraft use made it necessary to consider not only fire-retardant effectiveness but also aerodynamic smoothness, adhesion, flexibility, effect on tautness of the substrate dope, application characteristics, durability and resistance to gasoline, oil and ethylene glycol.

Although very few of the fire-retardant coatings that were developed in this investigation have the flexibility and durability of the cellulose acetate butyrate dope, several of them are of sufficient utility to merit further development. The film-forming bases which gave the best results all have considerable organically combined chlorine, which on pyrolysis gives off appreciable quantities of hydrochloric acid gas. Pigments such as zinc borate and antimony oxide were also quite effective in increasing the production of non-combustible gas. Magnesium ammonium phosphate, on the other hand, is too water-soluble for outdoor use. Antimony oxide and calcium carbonate in combination appeared to be superior to antimony oxide alone. The maximum pigment content compatible with flexibility and weathering requirements was about 40 percent of the solids. Although fire-retardancy is increased for higher pigment contents, such over-pigmented coatings are not sufficiently durable.

National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.

MOSTLY DILINOLEIC:

Dimer Acid

Dibasic acid, better known as a dimer acid, now is commercially available from Emery Industries, Inc. The dimer acid represents a commercial form of dimeric polymer consisting essentially of dilinoleic acid.

The new dimerization plant of Emery Industries permits production of an acid of light color and high dimer-trimer ratio at an attractively low cost.

Applications for Emery dimer acids are in polyamide resins, linseed and tung oil substitutes, polyesters, simple esters, sulphurized esters, resins, drying oils, paints, varnishes, soaps, plasticizers and emulsion breakers.

Uses for dimer acids are based on their chemical and physical characteristics. Dimer acids undergo the typical reactions of dicarboxylic organic acids. In some cases, utility is supported by physical properties such as low volatility, high flash and fire points, tackiness, viscosity.

Emery Industries, Inc., 4300 Carew Tower, Cincinnati 2, Ohio.

Chips of Salvaged Wood Turned Into Hardboard

At Forest Grove, Ore., the Forest Fiber Products Co. is successfully turning Douglas fir snags left in the wake of disastrous forest fires in the western Oregon Coast ranges into a usable hardwood product, called Forest Hardboard. Forest Fiber Products Co. is a subsidiary of Stimson Lumber Co., which also operates from salvaged logs at Forest Grove. Unusable wood at the Stimson mill, mostly short pieces, ends and similar material, is diverted to hardboard production by Forest Fiber Products.

Selected wood, bark-free and rot-free, is chipped, reduced to fiber and then to pulp. The pulp is deposited in slurry chests for chemical treatment. A special mixture of waxes and resins is used to give the board waterproofness. It is then run out in an endless blanket and cut to required lengths by a water jet. This product is compressed in a huge press under 180 lb. steam and at 450 deg. F. A humidifying process imparts a glassy surface to the hardboard. Packaging completes the process.

Finished product is in 4-ft. widths and 8- or 16-ft. lengths; thickness can be ⅛, $\frac{3}{16}$ or ¼ in. Various degrees of hardness are obtainable, from that approaching rock to that of a board that can be sawed and planed like ordinary lumber.

Uses of the product are many. The building industry can use it for construction purposes. It can also be used to make toys, counters, showcases, mirrors, picture frames and similar products.

Stimson Lumber Co., the parent organization, is the exclusive sales agent for Forest Hardboard.

Forest Fiber Products Co., Forest Grove, Ore.

FOR ACETATE FIBERS:

Red Dyestuff

First of an entirely new family of dyes for cellulose acetate fibers—Eastone Red GLF—has been announced by Tennessee Eastman Corp. The new dye is said to be exceptionally fast to light even in pastel shades, and far surpasses any known acetate red in this respect.

Other properties claimed for it include excellent fastness to gas fading, sublimation, crocking and hot pressing, as well as very good fastness to perspiration and washing. Good dischargeability is also reported.

Eastone Red GLF is a homogeneous, highly dispersed dye that produces a medium shade of red with a yellow cast. It possesses good exhaustion and level-dyeing characteristics with very good penetration and build-up at temperatures of 160 to 190 deg. F. Technical data and samples can be secured from the manufacturer.

Tennessee Eastman Corp., Kingsport, Tenn.

LUMPS:

Calcined Magnesia

General Magnesite & Magnesia Co. announces that it is now marketing calcined magnesia just as it comes from the kilns, packaged in heat-sealed polyethylene bags for protection from moisture and carbon dioxide. The magnesia reaches the user with its properties as a scorch-resisting material in neoprene undiminished.

Magnesia which is calcined for maximum scorch resistance in neoprene compounds is so sensitive to carbon dioxide and to moisture from the atmosphere that pulverizing, with consequent exposure of large surface areas to the air, greatly reduces its efficiency.

The fact that the material is now supplied in lumps instead of in powder form does not retard the rate of cure. The mixing stresses in Banbury mixers and on rubber mills are so great that the very fragile lumps are completely pulverized and dispersion in the rubber is at least equal to that of any powdered magnesia.

Results of independent tests have been uniformly favorable, and compounders of neoprene report satisfactory performance of the calcined magnesia in lump form.

By omitting the valueless grinding process, and packaging in polyethylene, an excellent barrier for both moisture and carbon dioxide, it is now possible to supply magnesia calcined for peak efficiency as a scorch-resisting material in neoprene.

General Magnesite & Magnesia Co., Plymouth Meeting, Pa.

REACTIVE:

Trifluoroacetic Acid

Research samples of a reactive fluorochemical are now being offered for sale by Minnesota Mining & Manufacturing Co. The compound is trifluoroacetic acid, CF_3COOH, a colorless, corrosive liquid that is one of the strongest organic acids known.

The acid has a strong pungent odor, boils at 71.1 deg. C. at 734 mm., and freezes at −15.3 deg. C.

Trifluoroacetic acid is a chemical intermediate that may prove useful in the preparation of such products as dyes, pharmaceuticals, resins and plastics. It will undergo most of the usual organic reactions of acetic acid.

Presence of the fluorine atoms contained in this fluorochemical enhances the flame resistance of compounds made from it.

The new fluorochemical, precursor of a group of fluorinated acids to be offered by Minnesota Mining, is made in the company's pilot plant in St. Paul by an electrochemical process. It is available in experimental quantities. Price is $10 a lb. Samples and technical data can also be secured.

Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

FLAME-RESISTANT:

Hydraulic Fluid

Development and production of Lindol HF-X, a new flame-resistant hydraulic fluid with a tricresyl phosphate base, is announced by Celanese Corp. of America.

As Lindol HF-X is not a chlorinated compound, it does not give off noxious fumes when exposed to very high temperatures. Because of this feature, coupled with its non-burning property, high lubricity, corrosion resistance and low cost, Lindol HF-X is expected to be widely employed by die-casters and users of such hydraulically operated installations as welding machines and coal mining equipment.

Lindol HF-X is available in a wide

(*Continued*)

range of viscosities and viscosity indices. It can be used in any system equipped for non-hazardous hydraulic fluid operation or in any other system with but few changes.

According to Celanese, the initial cost of Lindol HF-X is lower than that of any comparable material.

Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y.

Metal Cleaner: Brush It On, Wipe Dirt Off

For cleaning metal surfaces before applying an organic finish to them a new type cleaner has been developed by Enthone, Inc. This surface-preparing material is called Surprep. Essentially it is a solvent-phosphoric acid type cleaner that can be used on aluminum, steel and zinc surfaces. It degreases and prepares steel for painting at room temperature.

The product is a liquid that contains oil-displacing chemicals. It quickly dislodges oil, grease and other organic materials from metal surfaces so that they can be readily wiped off with a cloth or rinsed off with water. The new cleaner also contains phosphating and other rust-removal chemicals that dissolve rust, oxide and scale while the oil-removal agents operate.

Surprep is easy to apply. It is used either full strength or diluted with water. It is applied by brushing with a paint brush or wiping with a cloth. After several minutes the surface can be wiped off with a cloth, and it is then ready for painting. The surface can also be hosed off with water and then wiped dry. The surface is given a uniform etch and a light phosphate film is deposited that gives an excellent "tooth" for the paint.

Surprep is supplied in 1-gal. jugs, 5- and 12-gal. carboys, and 50-gal. bbl.

Enthone, Inc., 442 Elm St., New Haven 2, Conn.

AT REDUCED PRICES:

Krypton and Xenon

The rare gases krypton and xenon are slated for a host of new uses in a diversity of products and processes, now that Linde Air Products Co. is turning out these gases in big volume and at radically reduced prices. Until now, widespread use of these gases has been held back by their high cost.

Occurrence of krypton in the atmosphere is one part in one million; of xenon, one part in 12 million. Hence their separation and purification have presented complicated problems. But after five years of development work and considerable expenditures, Linde has turned the trick and is now producing krypton and xenon on a large scale. As a result, prices have been cut.

Krypton, xenon and the other rare gases are inert and will not combine with other elements under any conditions. This makes them superior to nitrogen for certain purposes, since nitrogen, although considered inert, will combine with many elements at elevated temperatures. Users of nitrogen will be encouraged to investigate the advantages of krypton, xenon, argon and the other rare gases.

How do krypton and xenon compare with argon, the most widely used rare gas? Krypton and xenon have the advantages of lower thermal conductivity, lower electrical resistance and lower ionizing potentials. Further research promises to uncover other unique characteristics of these gases and their mixtures.

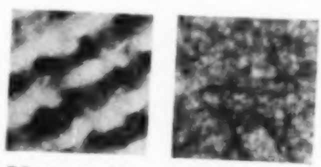
Krypton has been used recently to fill fluorescent lamps, miner's cap lamps and other minature lamps, and krypton or xenon might be used instead of argon for incandescent lamps. In these applications, krypton's properties may give either substantially longer life or increased operating efficiency and brightness, without increasing power consumption. Argon is now used in ionization chambers for tracking cosmic rays, an application where krypton and xenon hold promise of being superior. Geiger-Muller counters for detecting and measuring radioactivity use argon, krypton and xenon; the last two may be used in increasing quantities.

Xenon has replaced mercury vapor in certain thyratrons and vacuum tubes. Unlike mercury, xenon will not condense at low atmospheric temperatures, and has electrical properties similar to mercury vapor. Xenon is being used in photographic "speed lamps" of the gas discharge type, and for other specialized uses.

Refined krypton and xenon are available in 1- and 2-liter glass flasks, and in 400-, 500-liter and larger steel cylinders. The price of krypton in steel cylinders has been slashed more than 50 percent, that of xenon in cylinders somewhat less than 50 percent. Purity standards are high. The krypton contains less than 1 percent xenon; the xenon, less than 2 percent krypton. Trace quantities of oxygen and hydrogen and less than 500 ppm. of nitrogen are found in both gases.

Linde is interested in current research on krypton, xenon or argon that is being conducted by industry, the government or universities. The company stands ready to cooperate in rare gas research.

Linde Air Products Co., 30 East 42nd St., New York 17, N. Y.



Matted Cotton Filler Strengthens Laminate

A new material with exceptionally high impact fatigue values and superior machinability is being produced by the Synthane Corp., manufacturer of laminated phenolic plastics for industry. These properties, obtained without sacrifice in electrical or chemical values, stem from the use of a cotton mat filler whose fibers lie in random distribution within the laminations (above, right). Thus the texture of the new filler contrasts with the woven fabric used as filler in Grade C Synthane (above, left).

Even distribution of the matted, unwoven cotton fiber gives the new Grade L-RF a more uniform strength and superior resistance to repeated impact. The new mat material is made from a filler having long-fiber virgin cotton, and should not be confused with mat materials made from linters.

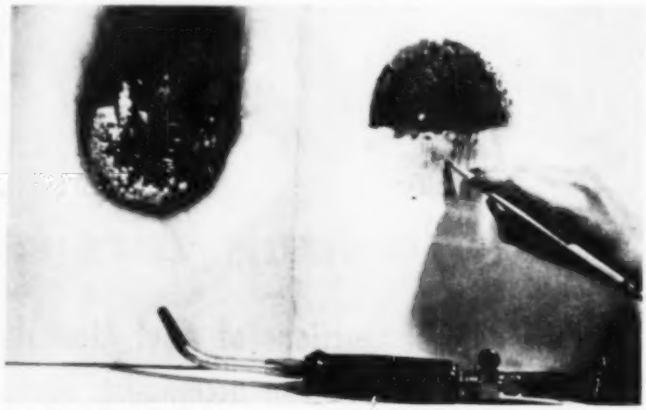
Average values for tensile, flexural and compressive strength of the new Synthane Grade L-RF considerably exceed the NEMA averages for Grade L and Grade C. It is in flatwise impact fatigue values, however, that Grade L-RF demonstrates its greatest superiority. Tests conducted by Synthane Corp., consisting of dropping a 1-lb. weight from a height of 1 ft. at a rate of 40 blows a minute on a notched impact specimen, showed that Grade L-RF resisted 5,000 blows,

(Continued)

as against 50 blows for Grade L and 100 blows for Grade C. Another outstanding characteristic of Grade L-RF is its ability to be machined to finish to a very smooth surface. These properties suggest many applications.

Grade L-RF is currently being produced in standard sheets, 36 x 36 in., in thicknesses ranging from $\frac{1}{32}$ in. up to and including 2 in. Thickness tolerances currently applicable to Grade L can be maintained in Grade L-RF, and closer tolerances can be attained by sanding operations. Grade L-RF is furnished in rod form in standard lengths of 36 in. and in diameters ranging from $\frac{1}{16}$ in. to a maximum of $1\frac{1}{4}$ in.

Synthane Corp., Highland Ave., Oaks, Pa.



Coating Retards Fire

Even when hit by the intense heat and flames from a welder's torch for five minutes a plywood panel coated with Sherwin-Williams' new fire-retardant paint failed to burn and char away (above, right). Instead, the flames turned the coating into a non-burning, marshmallow-like substance that protected the wood from fire. And when part of the substance was removed the original grain of the wood was found to be unharmed by the heat and flames. When the torch was applied for the same period to a panel covered with conventional paint the wood burned and charred (above, left).

This new paint, unlike earlier fire-retardant coatings, does not flake, has good resistance to moisture and adheres well to most surfaces. Developed on an experimental basis by Sherwin-Williams, it is designed for indoor uses —primarily for basement ceilings— and also for aircraft interior finishes. Its use as an undercoater for house paint is hoped for but is still in the realm of research.

A powder thinned with water, the new coating resembles clear varnish in appearance. Once applied, it may then be covered with a coating of conventional paint to provide color, if wanted, without impairing its fire-retardant action.

In another test, exposure to the flames of a blowtorch for 25 min. caused the coating to swell into an inch-thick spongy mass. The wood beneath was not even charred.

Sherwin-Williams points out that use of the new paint cannot guarantee a fireproof home. But it does give firemen another 15 to 20 min. to get a fire under control.

Temporarily known as Coating X, the new fire-retardant paint is available only for experimental purposes at present. The manufacturer is exploring further uses and conducting more exhaustive tests before making it commercially available.

Sherwin-Williams Co., 101 Prospect Ave., N.W., Cleveland, Ohio.

FOR WHITE ENAMELS:

Phthalic Alkyd Resin

Resinous Products Division of Rohm & Haas Co. is presently producing a new and unique film-forming resin. This resin permits the paint manufacturer to formulate a non-sagging architectural white enamel without using zinc oxide, thus affording excellent color retention in both light and darkness. Obviously, such a formulation avoids the disadvantage of yellowing in the dark that is characteristic of zinc oxide.

This new and radically different resin in the phthalic alkyd class is designated as Duraplex DX-656 by the maker. Although it is a long-oil soya type, it has characteristics not

(Continued)

available in any of the other Duraplex resins.

Specifically, it is said to show much greater flexibility and film length over long aging periods than does the usual oxidizing type alkyd resin. In addition, it is said to have excellent gloss retention, fast drying speed and extremely broad compatibility—extending to a wide range of drying oils, cold-cut varnish resins, varnishes, alkyd, and urea and melamine resins.

These characteristics have led to its adoption in architectural white enamels, automotive coatings, metal decorating coatings, cloth coatings and metal tube enamels. Its use is indicated in many diverse applications involving great toughness, flexibility and light color, coupled with fast air-drying or baking speed.

To take maximum advantage of the characteristics of Duraplex DX-656, a careful study of the drier combination should be made. The following combination of driers and anti-skinning agent, calculated as metal based on alkyd solids, has proved satisfactory: cobalt naphthenate 0.075 percent, manganese naphthenate 0.03 percent and guaiacol 0.25 percent.

Many architectural vehicles are supplied at lower viscosity and consequently a higher solids content than Duraplex DX-656. These very-high-solids materials often sag on vertical surface, but, of course, have high hiding power. If very high hiding power plus freedom from sagging is desired, a blend of Duraplex DX-656 with Duraplex D-65A or with an Amberol 801 varnish may be employed.

Rohm & Haas Co., Washington Square, Philadelphia 5, Pa.

FORM POLYMERS:

Maleic Esters

Three maleic esters—diethyl maleate, dibutyl maleate and di(2-ethylhexyl) maleate—are now being shipped by Carbide & Carbon Chemicals Corp. Major interest in maleic esters centers in their use as monomers for polymerization and copolymerization.

By adjusting reaction conditions and by choosing monomers judiciously, polymers can be produced that range from very brittle resins to soft, internally plasticized and readily extensible materials. In general, the lower molecular-weight esters yield the more brittle polymers, while esters of high molecular-weight alcohols tend to produce soft, flexible materials.

Polymers and copolymers of maleic esters have been used in many indus-

trial applications. Among them: coatings, films, molded products and textile specialties.

According to Carbide, other maleic esters, such as dimethyl, diisopropyl, dihexyl and diallyl maleates, can also be produced upon reasonable notice.

Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York 17, N. Y.

FREE-FLOWING:

Sodium Chloroacetate

Dow Chemical Co. at this time announces the immediate availability of technical-grade sodium chloroacetate, a free-flowing, stable powder.

A typical analysis of this product shows: 94.5 percent sodium chloroacetate, 1.5 percent sodium dichloroacetate, 0.5 percent sodium acetate, 0.5 percent sodium chloride and 3.0 percent water.

The product is available at the following prices: carload lots in 300-lb fiber drums at 20c. per lb.; less than carload lots in 300-lb. fiber drums at 21c. per lb.; and in 100-lb. fiber drums at 22c. per lb. All prices are fob. Midland, Mich.

Dow Chemical Company, Midland, Mich.

NON-IONIC:

Surface-Active Agent

Sharples Chemicals, Inc. presently is marketing Nome 218, a concentrated, liquid, non-ionic surface-active agent of the alkylene oxide adduct type. It possesses an unusual combination of detergent and wetting properties. In fact, it is seldom necessary to use more than one part of Nonic 218 in 2,000 parts of solution. This concentration gives a Draves-Clarkson sinking time of less than 25 sec. at 77 deg. F. and excellent detergency. Nonic 218 is effective over wide ranges of temperature and pH.

It is particularly useful: (1) where cationic or anionic agents are rendered inactive (salted out or neutralized); (2) in combination with either cationic or anionic agents to improve wetting, penetration and detergency; (3) where hard water conditions exist; (4) where quick and efficient removal of grease is required; (5) where cleansing and wetting action are required simultaneously; and (6) where good emulsifying properties are required.

A straw-colored liquid with a very slight characteristic odor, Nonic 218 has a specific gravity of 1.05 at 20 deg. C. Its viscosity at 77 deg. F. is 1.33 poises. Average weight per gallon is 8.5 lb. The concentration required for 25 sec. sinking time at 77 deg. F.

(*Continued*)

by Draves-Clarkson is 0.045 percent. Surface tension of a 0.05 percent solution is 28 dynes per cm. Interfacial tension, water against mineral oil, 0.05 percent solution, is 0.0 dynes per cm.

Nonic 218 is soluble in water, ethyl alcohol, acetone acetate, ethyl ether and amyl acetate. This non-ionic surface-active agent is available commercially from Sharples.

Sharples Chemicals, Inc., 123 S. Broad St., Phila. 9, Pa.

BUILDING BLOCKS:
Quartet of Organics

Four new organic compounds are announced by Heyden Chemical Corp. The chemicals are anisic acid, anisoyl chloride, o-chlorocinnamic acid and 4,4′-dichlorobenzophenone. As "building blocks" that have not been heretofore generally available, they will be of interest to chemists in various fields.

Most of the new compounds will be made in the versatile fine-chemicals manufacturing unit that was constructed not long ago at the Fords, N. J., plant of Heyden. These chemicals will supplement the standard products manufactured in the company's plants and will, to a large extent, be derived from them.

The anisic acid and the anisoyl chloride are already to be had in commercial quantities. All four of the new organics can be obtained in pilot-plant quantities.

Heden Chemical Corp., 393 Seventh Ave., New York 1, N. Y.

FOR COATINGS:
Styrene Resins

Bakelite Corp. announces the commercial availability of a new class of resins, promising wide usefulness in the manufacture of surface coatings. The resins are oil-modified styrene copolymer solutions and are designated as Bakelite C-10 Resins. Two types are currently available—BJS-501 and BJS-502.

BJS-501 is particularly recommended for interior architectural finishes, such as trim and wall surfaces in homes, offices and other buildings. Air-dry enamels of exceptionally high gloss and "build" are produced. They may be applied easily by brushing and are superior to conventional enamels in resistance to fogging in interior exposure. The resin is pale in color, promoting wide color possibilities, and in addition, has good color retention, good pigment suspension and stability even with reactive pigments. Mineral spirits can be used as the sole solvent.

Enamel finishes that air-dry as fast

as lacquers can be made from Bakelight C-10 Resin BJS-502. They are already being used for toys and farm implements, where it is an advantage to be able to handle such items 8 to 10 min. after spray application.

Baking-type enamels based on BJS-502 offer great usefulness in meeting short baking cycles. For example, enamels will bake to a Walker-Steele hardness of 137 sec. in 30 min. at 250 deg. F. At 300 deg. F., such enamels bake to a hardness of 141 sec. in 20 min. BJS-502 also features good stability, suspension of pigments and color retention.

Compatibility of these resins and other pertinent data have been studied, and it is expected that these products will find wide usefulness.

Bakelite Corp., 30 East 42nd St., New York, N. Y.

CRYSTALLINE:

Dihydrostreptomycin

Heyden Chemical Corp. presently is making commercially available dihydrostreptomycin sulphate in crystalline form. This crystalline form of dihydrostreptomycin has permitted the establishment of new high standards of purity and potency. These include a minimum assay value of 725 mcgs. per mg., compared with the present 600, and less than 1 percent unreduced streptomycin sulphate, against the maximum of 3 percent heretofore established.

Heyden, long active in the development and manufacture of antibiotics, has been producing the dihydrostreptomycin since last fall. Until now, however, it had been marketed only in noncrystalline form.

The new form is readily available in adequate supply as a result of expanded production. It will be made available to hospitals and doctors at no increase in cost, according to Heyden.

Heyden Chemical Corp., 393 Seventh Ave., New York 1, N. Y.

NEW PRODUCERS:

Sodium Hydride

Metal Hydrides, Inc., announces the availability of research quantities of sodium hydride. Under arrangements recently completed with Du Pont, Metal Hydrides will manufacture and sell this product. Construction of a new plant has been started. While this plant is not yet completed, if present engineering schedules are maintained, commercial quantities of sodium hydride will be available early in the fall of this year.

Meantime, Metal Hydrides, Inc., has made available to all interested

(Continued)

parties sufficient material for development and research purposes. Technical data and information, as well as proposed shipping schedules, may be obtained by contacting Metal Hydrides in Beverly, Mass.

Metal Hydrides, Inc., 12-24 Congress St., Beverly, Mass.

CHIP-RESISTANT:

Cold-Pour Plastic

Palestic Corp., having completed development and full-scale industrial tests, is now turning out a new low-cost resin-bonded gypsum. Called Palestic, it is a cold-pour plastic, cast as readily and as rapidly as is plaster. No pressure or heat is required. Palestic is a strong, hard, durable, chip-resistant material. Basically, it is a resin-bonded gypsum in which the gypsum is interlocked with the resin.

This product has been proved in large-scale shop tests that lasted more than two years. It has been found practical for the production of many industrial, novelty, art and household items.

Having a wide range of uses, this product is very low in cost and can be readily prepared and handled. Palestic costs about 5c. a lb.

Palestic Corp., 316 North Laflin St., Chicago 7, Ill.

HIGHLY BASIC:

Anion Exchanger

Resinous Products Division of Rohm & Haas Co. is now making Amberlite IRA-400, the new, strongly basic anion exchanger which markedly increases the scope of ion exchange technology. This is said to be the first resin absorbent which can be utilized to split neutral salts completely; that is, to convert salts to the corresponding free bases of the metallic ions.

One of the important contributions of the new anion exchanger is the direct removal of silica from feedwater for high-pressure boilers. IRA-400 will adsorb negatively charged ions from acid, neutral and even mildly alkaline solutions in a pH range from 1 to 10.

This exchanger behaves as solid caustic with only its hydroxyl ions in solution. Its reaction as a strongly dissociated base largely explains its extraordinary exchange rate—far greater than other anion exchangers. This rapid rate of exchange is a very desirable feature where batchwise techniques are practicable.

Thus it offers new opportunities for ion exchange methods in specialty applications apart from water conditioning. For example, it adsorbs all

amino acids with isoelectric points below pH 10. And in de-ashing operations, it is capable of removing the anionic impurities first—a reversal of the usual de-ionization procedure. This technique permits safe treatment of solutions that would be adversely affected by exposure to low pH.

According to the manufacturer, the resin can actually be mixed intimately with a strong cation exchanger to prepare an adsorbent bed that will completely de-ionize solutions in one column and in one step.

Resinous Products Div., Rohm & Haas Co., Philadelphia, Pa.

NON-IONIC:

Synthetic Detergents

Antara Products, General Aniline & Film Corp., Inc., has introduced two new non-ionic synthetic detergents. These products, Antarox A-400 and A-480, are displaying versatility at low cost in many different detergent applications.

The fact that these two new detergents of the aromatic polyethylene glycol ether type are practically odorless, says the manufacturer, makes them particularly valuable for the specialized demands made upon detergents today.

Antarox A-400 and A-480, because of their ether structure, are extremely stable in the presence of acids, alkalis and electrolytes. Because they do not ionize, they will not form insoluble compounds in hard water. They do not easily decompose or separate.

The new Antaroxes are foamers, according to Antara Products, making possible the formulation of products with consumer appeal. Their physical and chemical properties will not change over long periods of storage. They also are capable of withstanding wide variations in temperature.

Samples of Antarox A-400 and A-480, as well as complete technical information on their characteristics and applications, are available from General Aniline & Film Corp.

General Aniline & Film Corp., 444 Madison Ave., New York 22, N. Y.

LICKS BRITTLENESS:

Plasticizer for Urea Resins

Glyco Products Co. has come up with a plasticizer to overcome brittleness in certain urea-formaldehyde compositions. The product is Diglycol Stearate S.

Urea-formaldehyde adhesives for plywood and veneer board tend to be very brittle after they set. These adhesives are apparently quite difficult to plasticize. This has imposed great limitations on their use. Coatings

(Continued)

and impregnations of textiles and paper with urea-formaldehyde resins and compositions suffer from the same disadvantage.

Incorporation of about 2 percent Diglycol Stearate S in such products plasticizes them effectively, preventing them from becoming brittle. The bonding action is not affected. Diglycol Stearate S is a white, wax-like product having a slight agreeable fatty odor.

Glyco Products Co., 26 Court St., Brooklyn 2, N. Y.

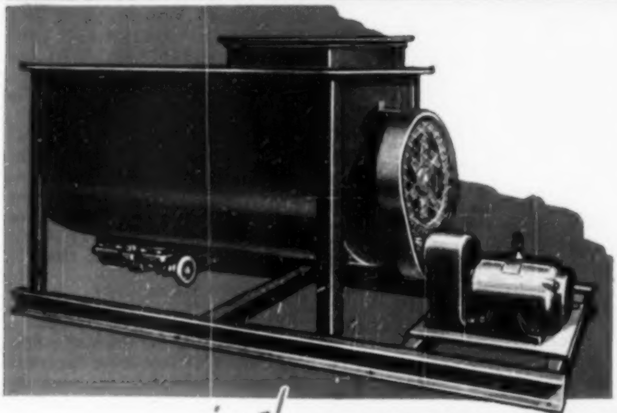
Briefs . . .

Isobutyl alcohol is now in volume production at the Bishop, Tex., plant of the Celanese Corp. of America. The added production will open up new uses. Isobutyl alcohol is used in plasticizers, alkylated urea resins, esters, extractants, general solvents and brake fluids. Celanese has set the delivered price at 12¼ c. a lb. in tank cars and 14 c. a lb. in carloads or drums. *Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y.*

Phenolphthalein glucuronide, now commercially available from the Sigma Chemical Co., is vital in the study of glucuronidase activity in animals and man. Until now, its preparation involved long and elaborate procedures. With the introduction of this high-purity substrate, time can be saved on important research. *Sigma Chemical Co., 4648 Easton Ave., St. Louis 13, Mo.*

Betachlor, latest of Wyandotte's organics, consists of 57 percent β, β'-dichloroethyl ether and 43 percent β, β'-dichloroisopropyl ether. A solvent for oils, fats, waxes and greases, it has possibilities in extraction processes, textile processing and the formulation of cleaning compounds. It is a solvent for resins and film formers, and in intermediate in synthesizing resins. As a soil fumigant, Betachlor effectively controls insect infestation. *Wyandotte Chemicals Corp., 1609 Biddle St., Wyandotte, Mich.*

Stabilizers for foods and cosmetics are dehydroacetic acid and its sodium salt. Laboratory tests and field trials of DHA and DHA-S, as Dow has trademarked them, show their promise as inhibitors of the bacteria, fungi and yeasts commonly encountered in manufacturing and processing cosmetics, food and food packaging materials, and beverages. *Dow Chemical Co., Midland, Mich.* —End



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- Easy Maintenance, as entire Agitator can quickly be lifted from tub.
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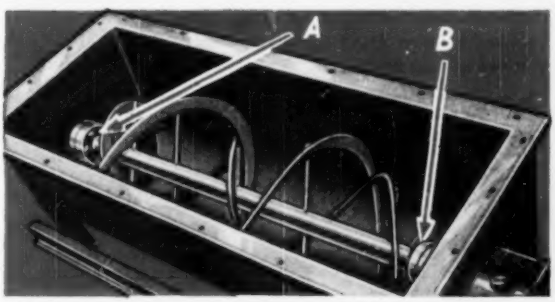
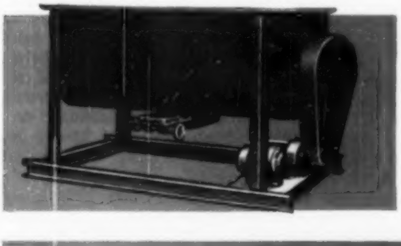


Note how Agitator Spirals can easily be taken out.

By removing the bolts from the two companion flanges, A & B, above, the entire bolted shaft assembly containing the two spirals can be lifted from the Mixer tub. Therefore, no slotted end sections in the tub are required, which sections may tend to leak dust or liquid.



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Rotary Filter-Dryers

(*Continued from page 127*)

0.890. Therefore $(V/C_r) = 237/0.890 = 267$. From Fig. 4, at $(V/C_r) = 267$ and $S_r = 0.238$: $(t/C_t) = 302$. Time in drying zone, $t = (270°/360°)\ (99) = 74.25$ sec. Therefore, $C_t = 74.25/302 = 0.246$. Eq. (8) of last month's article gives $C_t = \mu_L X (L_{1\text{-}avg})^2/K\Delta P_{1\text{-}avg}$; substituting in that: $0.246 = (0.512)\ (0.000672)\ (0.40)\ (1.027/12)^2/(2.46 \times 10^{-8})\ \Delta P_{1\text{-}avg}$. From which $\Delta P_{1\text{-}avg} = 159$ lb./ft.^{2} Therefore $(\Delta P/L)_{1\text{-}avg} = (\Delta P/L)_1 = (159)/(1.027/12) = 1{,}878$ lb./ft.^{2}ft. $= 1{,}878/845 = 2.22$ in. Hg/in. cake. From Fig. 4 of last month's article, at $K = 2.46 \times 10^{-8}$ and $(\Delta P/L)_1 = 2.22$ in Hg/in. cake, $F_t = 0.67$. From Fig. 2 of this article, at $(T_e + 460)/(T_a + 460) = (154 + 460)/(600 + 460) = 0.579$ and $F_t = 0.67$: $(\Delta P/L)_1/(\Delta P/L)_2 = 0.44$. From which $(\Delta P/L)_2 = (2.22/0.44) = 5.04$ in. Hg/in. cake.

(6) Calculation of Vacuum Required: $\Delta P = L_{1\text{-}avg}\ (\Delta P/L)_1 + L_{2\text{-}avg}\ (\Delta P/L)_2 = (1.018)\ (2.22) + (0.367)\ (5.04) = 2.25 + 1.85 = 4.10$ in. Hg, or 289 lb./ft.^{2}

(7) Cake Deposition Zone: From Eq. (2) of last month's article, $C_L = (\mu_L/2K\rho s)\ [\rho'(1 - s)\ (1 - X) - \rho s X] = [(1.13)\ (0.000672)/(2)\ (2.46 \times 10^{-8})\ (62.4)\ (0.2)]\ [165\ (1 - 0.2)\ (1 - 0.4) - (62.4)\ (0.2)\ (0.4)] = 9.17 \times 10^4$ lb. sec./ft.^{4} Necessary time to deposit the cake (Eq. 1, last month's article): $t' = C_L L^2/\Delta P = (9.17 \times 10^4)\ (1.385/12)^2/\ 281 = 4.33$ sec. Actual time in deposition zone, $t = (30/360)\ (99) = 8.25$ sec. Since actual time is greater than necessary time, the desired cake thickness is controlled by the feed rate.

(8) Air Flow Through Cake During Dewatering: $C_t = \mu_L X L^2/K\Delta P = (1.13)\ (0.000672)\ (0.40)\ (1.385/12)^2/(2.46 \times 10^{-8})\ (281) = 0.583$ sec.; $t = (30°/360°)\ (99) + (8.25 - 4.33) = 12.17$ sec.; $t/C_t = 12.17/0.583 = 20.9$. From Fig. 2 of last month's article (which is an enlargement of the low-range section of this month's Fig. 4), at $S_r = 0.238$ and $t/C_t = 20.9$: $V/C_r = 11.7$; $C_r = XL\ (\mu_L/\mu_a) = (0.40)\ (1.385/12)\ (1.13/0.0176) = 2.96$ ft.^{3}/ft.^{2}-cycle; $V = 11.7C_r = (11.7)\ (2.96) = 34.6$ ft.^{3} air/ft.^{2}-cycle.

(9) Air Flows in CFM: Corrections to obtain air flows in cfm. at conditions at intake of blower (i.e., 4.10 in. Hg vacuum and saturated at 130 deg. F.), neglecting pressure drop in lead lines: (a) Turbulence correction from Fig. 4 of last month's article: At $(\Delta P/L) = 4.10/1.385 = 2.96$ in. Hg/in. and $K = 2.46 \times 10^{-8}$ you get $F_t = 0.62$. (b) Pressure correction, (F_p) = (avg. pressure in cake)/(inlet pressure to blower) $= (29.92 - 0.5 \times 4.10)/(29.92 - 3.98) = 1.080$. The cfm. to blower from cake deposition and dewatering zones $= (34.6)\ (0.62)\ (1.080)\ (25)\ (60/99) = 352$ cfm. Air flow in drying zone, cfm. (at 4.10 in. vac. and sat. at 130 deg. F.): Humidity (sat.) $= (18/29)\ (4.525$ in. Hg$)/(25.82 - 4.525) = 0.132$ lb. H_2O per lb. dry air. So cfm. $= (140.2)\ (1.132)\ [359/(29 + 18 \times 0.132)/1.132]\ (590/492)\ (29.92/25.82) = 2{,}840$ cfm. Total intake to blower $= 2{,}840 + 352 = 3{,}190$ cfm. at 130 deg. F. and 4.10 in. Hg.

(10) Preheater for air (Direct Contact Type): Assuming volume of flue gas in exit stream to be negligible: cfm. fuel gas = (lb. air/min.) (temp. change) (spec. heat)/(net heating value of fuel gas) $= (140.2)\ (630 - 70)\ (0.25)/(535) = 37.3$ cfm.

SUMMARY

The thickness of moist portion of the cake leaving the drum of a filter-dryer should be kept above the critical moist-cake thickness for maximum drying efficiency. The critical moist-cake thickness is the thickness at which the instantaneous drying efficiency is 90 percent. Fig. 1 shows the critical moist-cake thickness as a function of cake permeability and pressure gradient. The cake may be completely dried by mixing the wet and dry portions after the cake leaves the drum.

Calculations for a filter-dryer are made by two heat balances, Eqs. (4) and (5), the first giving the thickness of the moist portion of the cake leaving the drum, and the second the amount of preheated air required. The pressure gradient across the moist portion of cake is calculated from the air flow, permeability, and a turbulence factor. The pressure drop across the dry cake is calculated from the temperatures and turbulence factor by use of Fig. 2. This gives the total pressure drop across the cake. The air flow during cake deposition and dewatering and the moisture evaporated are added to the air required for drying to obtain the total blower requirements.

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2. Brownell, L. E., and Katz, D. L., *Chem. Eng. Progress*, **43**, 537 (1947).
3. Brownell, L. E., and Katz, D. L., *Chem. Eng. Progress*, **43**, 601 (1947).
4. Brownell, L. E., and Katz, D. L., *Chem. Eng. Progress*, **43**, 703 (1947).

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

New 100 x 350-ft. building of two, three and four story design houses the biological process for Chloromycetin, it can be used also for other antibiotics.

Chloromycetin Production

Biological Process

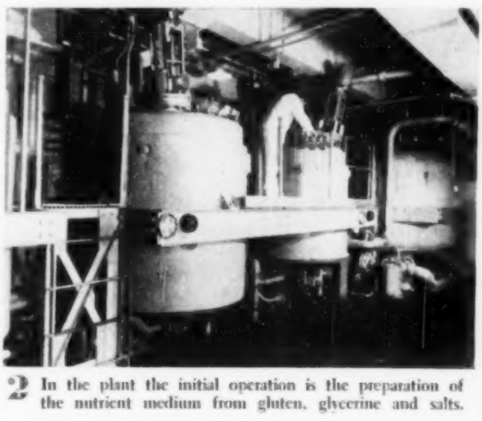
Article on page 107

Discovery and proof of a new antibiotic, Chloromycetin, by Parke, Davis & Co. during 1947 was followed closely by the development first of a biological process for commercial production, then of a synthetic process which is portrayed on p. 112.

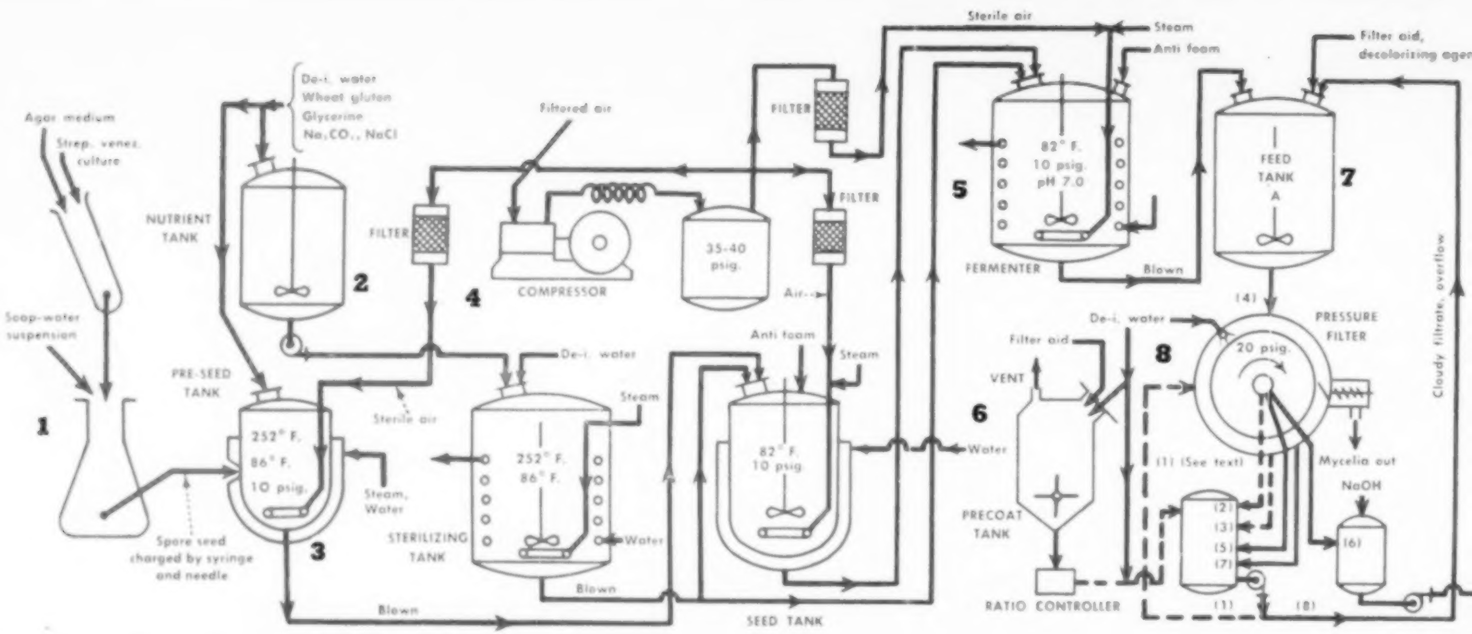
Seed spore, prepared in the laboratory from the parent mold, is grown in the plant, first in 50-gal. pre-seed tanks, then in larger batches in 500-gal. seed tanks, and finally in 5,000-gal. fermentation tanks, using a nutrient medium consisting of wheat glutin, glycerine, sodium carbonate and sodium chloride. Mold growth is aerobic, using sterile air under close temperature control. The resulting broth containing a very dilute solution of Chloromycetin, is then filtered, concentrated by extraction and evaporation, crystallized and recrystallized, pulverized, screened and packed for shipment.

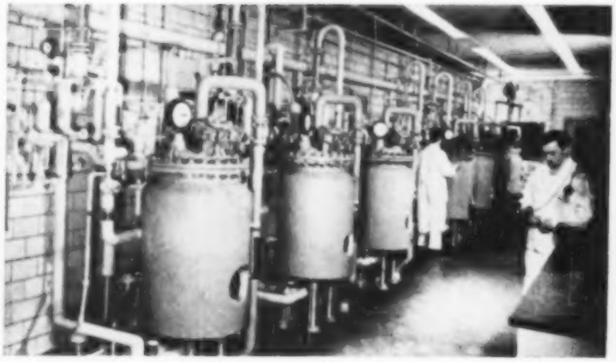
Removal of the mycelia from the broth is accomplished in a precoated rotary pressure filter, care being taken to preserve the washings and the filter contents at the end of the run. The clarified broth is neutralized and extracted with amyl acetate in a centrifugal countercurrent extractor, a five-to-one volume reduction. Further concentration to about 1 percent of the original batch is the result of vacuum evaporation. The concentrate is washed with acid, alkali and water, further evaporated to about 0.05 percent of original volume and refrigerated to crystallize the crude product which is dissolved in hot water, carbon treated and recrystallized prior to final filtration and drying. Pulverizing and screening complete the manufacturing operations.

1 Chloromycetin production starts with propagation of the mold strain under conditions of close laboratory control.

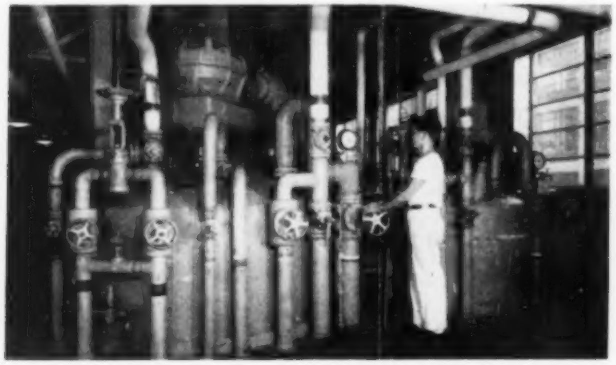


2 In the plant the initial operation is the preparation of the nutrient medium from gluten, glycerine and salts.

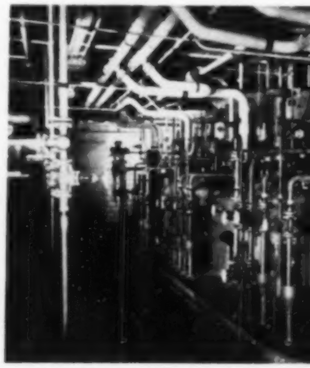




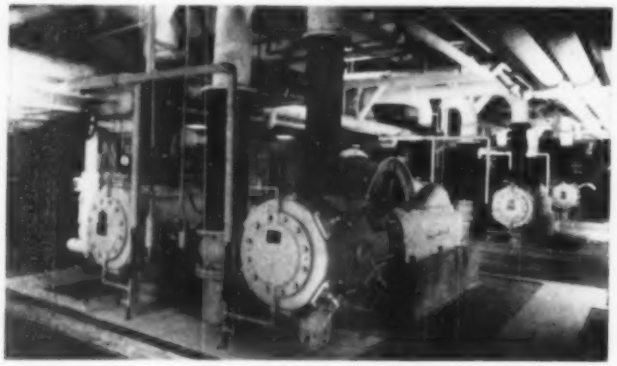
3 Seven 50-gal. pre-seed tanks are used to grow the seed spore received from the laboratory; completed, each tank's contents is blown to a seed tank.



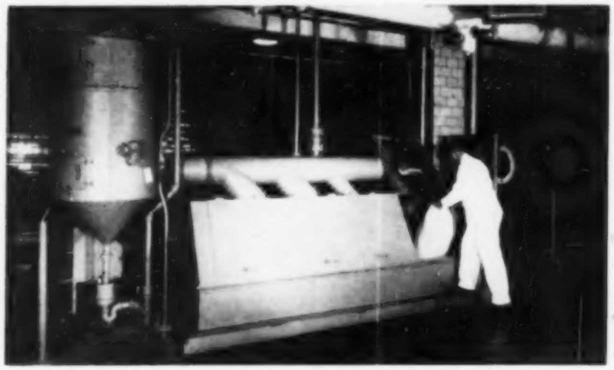
5 Here is a 500-gal. seed tank (right) and a 5,000-gal. fermenter; seven of each are in use, turning out fermentation batches in a 76-hr. period.



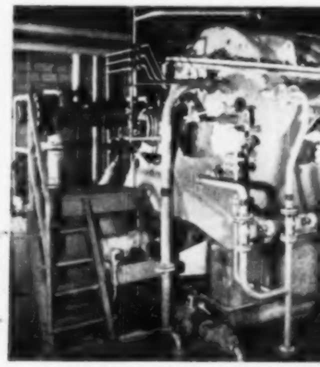
7 Two of these 3,000-gal. tanks are u from the fermenters, as well as clou



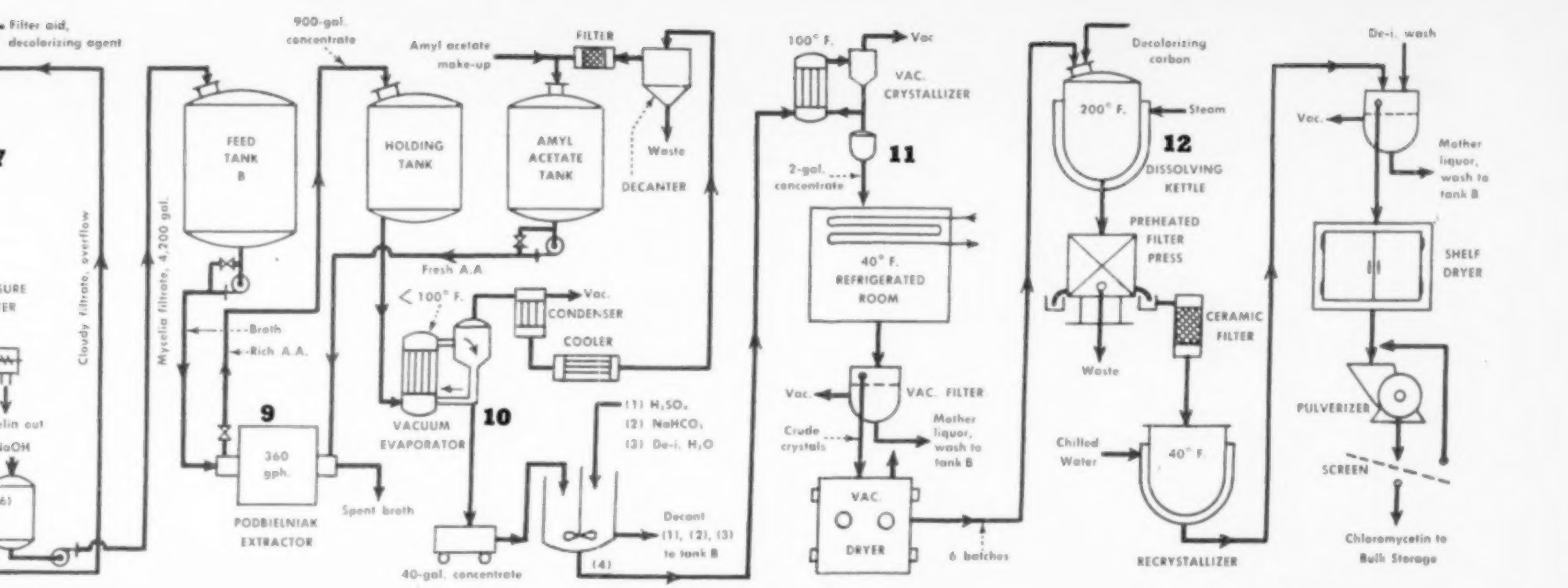
4 Air required for the aerobic growth of the Chloromycetin-producing mold is filtered, compressed in carbon-ring compressors, and filtered again.

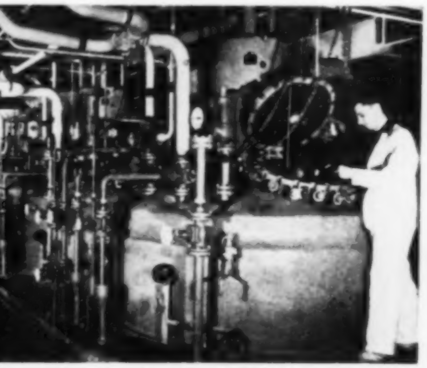


6 These agitated and ventilated hopper mixers in the preparation room make initial suspensions of filter aids, as well as solids for nutrient media.

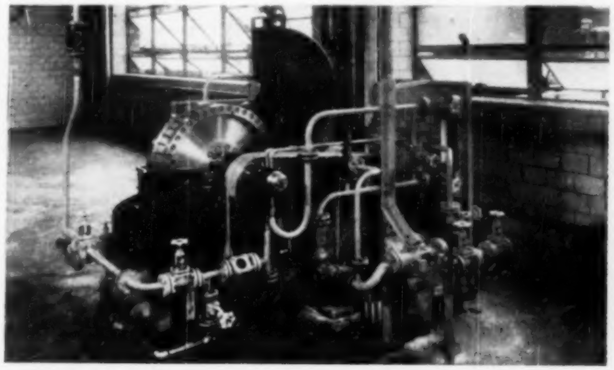


8 Eliminating mycelia from the broth coat rotary filters, each having a capaci

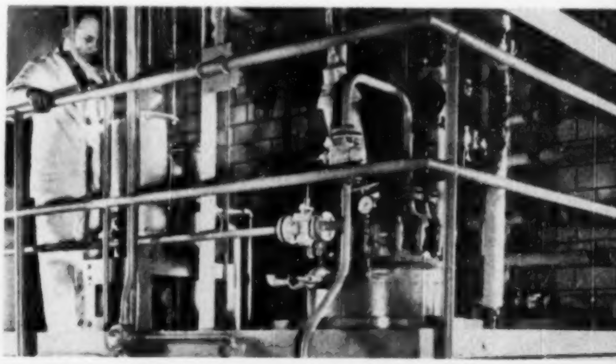




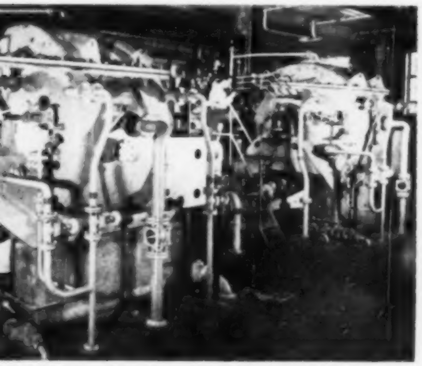
0-gal. tanks are used as filter feed tanks, receiving broth
s, as well as cloudy filtrate and filter overflow.



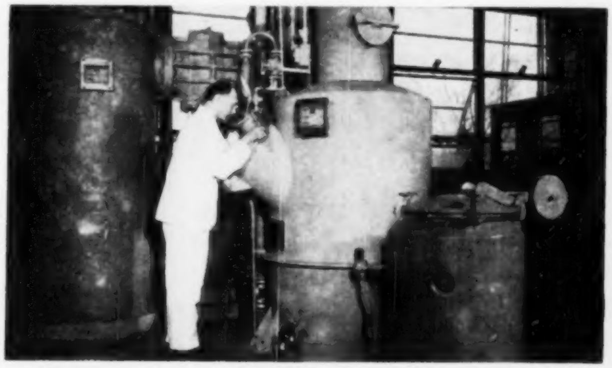
9 Clarified broth is concentrated about 5 to 1 by extraction with amyl acetate in this centrifugal countercurrent contactor at 360 gph. total flow.



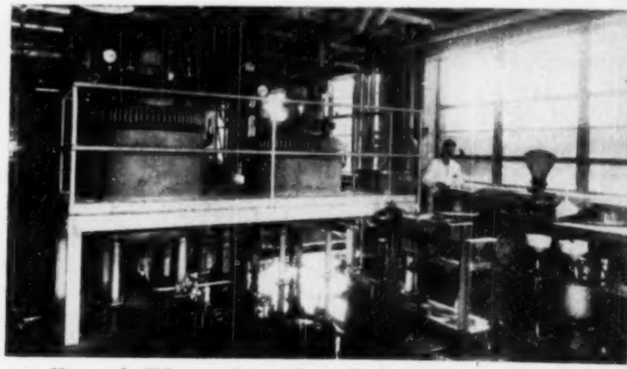
11 The washed 40-gal. extract, further evaporated in this glass vacuum crystallizer, yields a small volume of crude crystals.



from the broth requires filtration in two pressure pre-
h having a capacity of 1,000 gph. at 20 psig.



10 Vacuum evaporation at less than 100 deg. F. further concentrates the Chloromycetin extract to about 1 percent of the volume of the original batch.



12 Here crude Chloromycetin crystals are dissolved in water, carbon treated, filtered, recrystallized and then vacuum filtered.

Detergents with WYANDOTTE CARBOSE*

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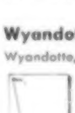

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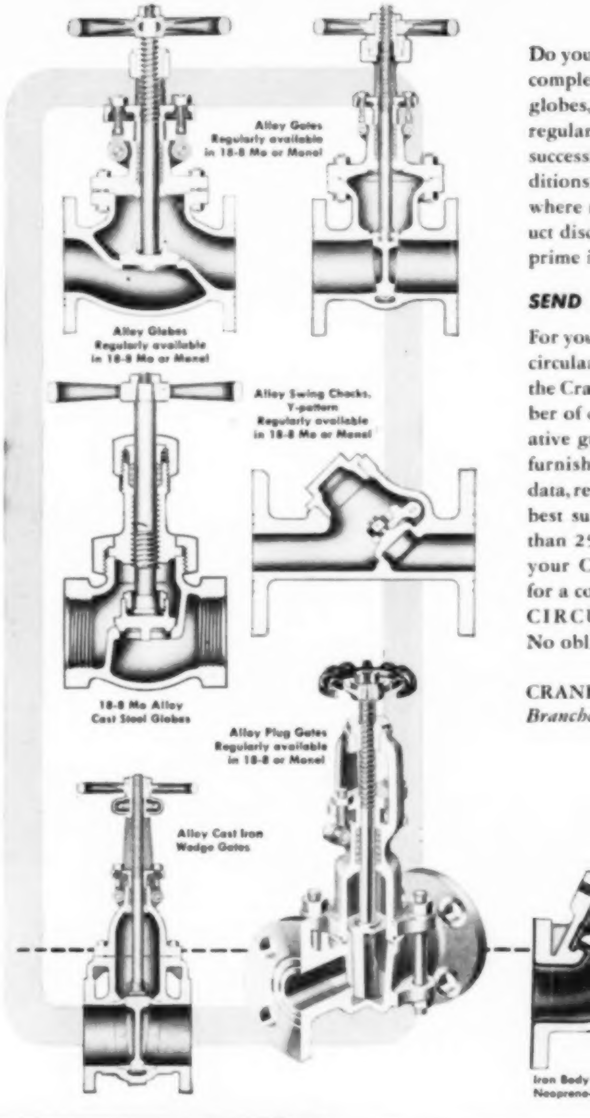

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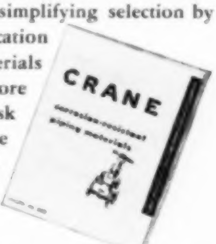

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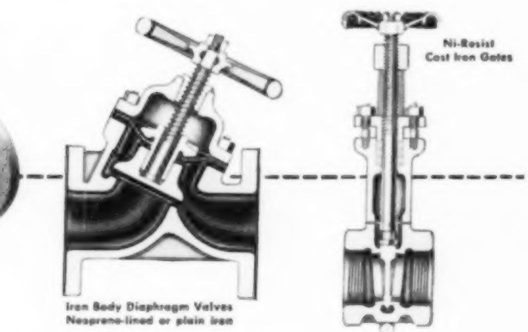

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The Vertical Mill is well suited to smaller batch operations which involve the frequent changing from one grade of insecticide to another. The ease with which this unit is cleaned out reduces the contamination problem to a minimum.

The Raymond Roller Mill finds wide application for the continuous, large scale production of insecticide powders. The Whizzer Separator provides a wide range of fineness control by means of one simple adjustment.

Specially equipped Roller Mills also are available for producing fine grades of dusting sulphur, and for pulverizing rotenone bearing materials, such as cubé root, derris root and pyretheum flowers.

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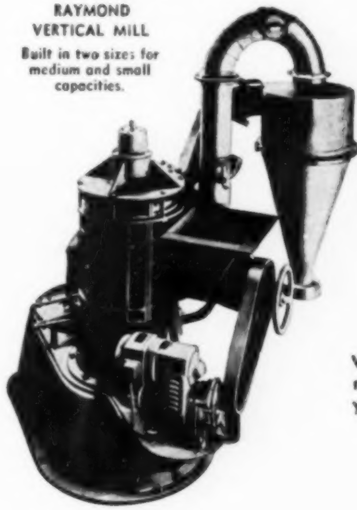

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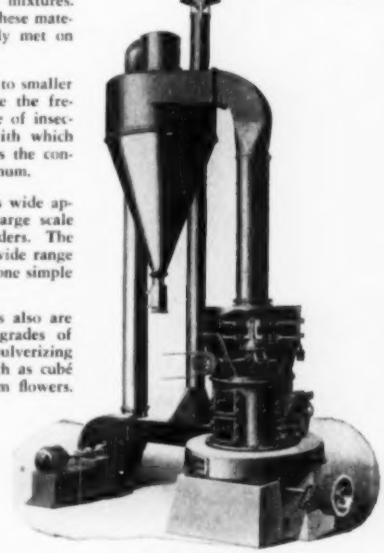

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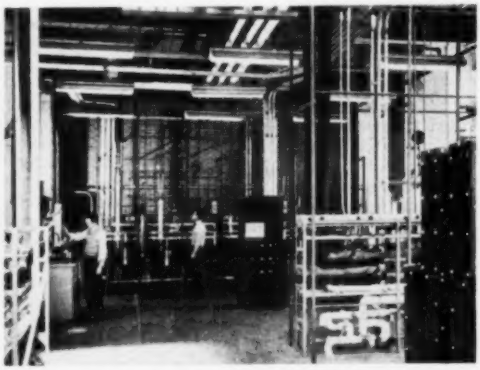
Chemical Engineering News

JOSEPH A. O'CONNOR, *Assistant Editor*

New research center of Carbide & Carbon Chemicals Corp. at South Charleston, W. Va., extends over a 140-acre area.



Researchers carry on studies in organic synthesis in this large-scale laboratory at Carbide's new research center.

Carbide's New Research Center to Concentrate on Basic Research and Process Development in Organic Field

The new research center of Carbide & Carbon Chemicals Corp., one of the largest and most modern in the U.S., has just been completed by H. K. Ferguson Co. Situated on a 140-acre site near Carbide's South Charleston, W. Va., plant, the laboratories will be the center of the company's fundamental research in plasticizers, resins and organic chemicals. Process development will also be carried on at the center in four large buildings to be occupied in the future.

A three-story T-shaped structure of brick and steel, the main laboratory building is 325 ft. long and 96 ft. deep. It contains 69 individual laboratories, 48 offices, a large-scale laboratory and an auditorium that seats 125 persons.

Fourteen utilities are available at each laboratory desk. These include hot and cold water, distilled water, cold brine, fuel gas, compressed air, vacuum, nitrogen and low-pressure steam. High-pressure steam and hydrogen are provided where needed.

Highly flexible, the laboratories are laid out in sections or modules 13 ft. wide with a depth of 24 ft. The standard unit for two or three workers is thus 13 x 24 ft., and this may be doubled or tripled by increasing the length to 26 or 39 ft.

Rearrangement of laboratory units does not interfere with mechanical services or air-conditioning, which were designed to fit the basic 13-ft. section.

All laboratory and office space is air-conditioned and each room is provided with individual thermostatic control. Incoming air is cleaned by electrostatic precipitators and is cooled by a 600-ton refrigeration system. One laboratory is equipped to maintain constant temperature and humidity conditions the year round for research purposes.

Possibility of cross-contamination between areas has been eliminated by maintaining each laboratory at a slight negative pressure with reference to offices and corridors. Another familiar problem of the ventilating engineer—the loss of conditioned air through fume exhaust doors—was solved by providing each hood with an independent supply of clean, tempered air. When a hood is put in operation, a lever is thrown that opens the air supply ducts and doubles the speed of the exhaust fan.

A special high-pressure laboratory, located at the rear of the site, will be used to study the behavior of chemical reactions at extreme pressures. Elaborate precautions for the protection of operating personnel include an 18-in. reinforced concrete barrier between control stations and high-pressure cells.

Outstanding among the physical testing equipment at the center are an electronic microscope, a mass spectrometer, a vacuum coating unit for electron-micrographs, an X-ray diffraction unit, a microdensitometer, and ultraviolet and infrared spectrometers.

A number of Carbide's products, developed by research workers who will occupy the new quarters, were used in the construction of the center. Vinylite plastics found their way into floor tile and upholstery. Electrical wiring was insulated with either vinyl or polyethylene materials.

Dow Gets Drop on Hurricanes By Elaborate Warning System

The hurricane warning system and evacuation program of Dow Chemical Co., Freeport, Tex., features use of radar and a shortwave radio hookup.

Dow has barometer stations from Brownsville, Tex., to Louisiana and a radar station at Freeport. Humble Oil & Refining Co. also operates a radar station on contract at Swan's Island, La., and the O'Connor family is operating one in Victoria. Findings of these stations are all correlated with the United States Weather Bureau.

Cooperation of individual companies along the Gulf Coast and with the Weather Bureau in hurricane-tracking is all important, according to A. T. Deere, Dow plant production head at Freeport.

Gulf Coast companies, Deere points out, are attempting to secure from FCC permission for a radio hookup to disseminate weather information.

(Continued)

But this is being held up until a frequency can be assigned.

Dow's system calls for a 12-hr. warning, at which partial shutdowns are started, then 6-hr. and 4-hr. warnings and finally shutdown, at which workers evacuate. Telephone and radio contacts have been established with which to contact evacuees in inland points to notify them when to return.

The Dow plan, explains Deere, also is the basis for the extensively worked-out Red Cross disaster plan for Brazoria County, which covers hurricane warning and evacuation for all citizens.

Dow now has its own shortwave radio system, through which Houston radio stations may be reached. This assures full communication even when telephone lines are down.

Isco Acquires Browning As California Outlet

Innis, Speiden & Co. has acquired E. S. Browning Co., San Francisco and Los Angeles, Calif. The E. S. Browning Co., which represents a large number of chemical manufacturers, will continue to operate under its own name. But it will sell, in addition to its own line, all of Innis, Speiden's chemicals, gums, waxes and insecticides.

E. A. Smith, formerly with Innis, Speiden in New York as head of the gum department, has joined the Browning organization and will coordinate the activities of the two companies. Edgar S. Browning remains as president and general manager of the California firm.

New Finishes Laboratory in Philadelphia for Du Pont

Construction work has started in Philadelphia on the Marshall Laboratory of E. I. du Pont de Nemours & Co., Inc., named in honor of John Marshall, director of the Chemical Division of the Fabrics & Finishes Department. To be completed late in 1950 at a cost of $2 million, the new four-story building will replace laboratory facilities now located in three different buildings on the grounds of the Du Pont finishes plant in Philadelphia.

The Marshall Laboratory will provide facilities for 80 technical employees. Laboratory assistants, clerical and maintenance employees will bring the total staff up to about 185.

The building, of red brick, will be of functional design. It will be L-shaped, with one wing 216 ft. long and the other one 129 ft. The building will be air-conditioned. Each individual laboratory room will be provided with all services required.

Marshall Laboratory also will have administrative offices, conference rooms, a library, a physics laboratory, both constant and variable temperature-humidity rooms, an analytical section, spray and oven rooms, photographic light and dark rooms, an equipment "laundry" room and a shop.

John Marshall, who joined Du Pont in 1913, played an important role in the development of the Dulux synthetic resin enamel finishes. In 1945, when all technical activities of the Fabrics & Finishes Department were consolidated in a single Chemical Division, Marshall became its first director. In that capacity he had a key role in the planning for the new building, little suspecting that it would be named in his honor.

SMILING PUPILS, GENIAL INSTRUCTOR

Smiling appreciatively, two chemists and a vice president get some pointers from a genial chemical engineer. The engineer, G. I. Klein, is explaining a step in the production of Victor insecticide ASP 47. Looking and listening are W. H. Woodstock, assistant chief chemist, Dr. H. Adler, chief chemist, and O. H. Raschke, vice president. All four are with Victor Chemical Works. Occasion was visit to Victor's Chicago Heights, Ill., plant. The plant trip was a feature of the company's annual sales meeting in Chicago in September.

Blaw-Knox Extraction Plant For Cargill at Chicago

Construction of a large soybean processing plant for Cargill, Inc., has just been started by the Chemical Plants Division of Blaw-Knox Construction Co. The new plant will be located on the bank of the Calumet River in Chicago, next to the grain company's large storage elevators. Cargill, Inc., is one of the world's biggest grain dealers and elevator operators.

The "turnkey" award to Blaw-Knox covers the design and construction of buildings, carloading equipment, yard storage and all process facilities including meal grinding and sifting.

Included in the process equipment are a basket extractor, Lewis flaking mills, two vapor desolventizers, two pressure toasters and two deodorizers—the last four items representing exclusive designs of the contractor.

Cargill's location will permit water shipments of some of the meal product.

Completion is expected in 1950. The project will give Cargill one of the largest soybean solvent-extraction processing plants in this country.

Texas Chemical Executives Named to Regents Board

Top executives of the Texas chemical industry have been named by Governor Allan Shivers to the new board of regents of Lamar State College of Technology at Beaumont, Tex.

The regents board includes: Clark Barrett, assistant manager of the Orange plant of E. I. du Pont de Nemours & Co., Inc.; A. P. Beutel, vice president of Dow Chemical Co., located at Freeport; Joseph Mares, vice president of Monsanto Chemical

(Continued)

up from the minor leagues

comes stainless sheet and strip

Stainless steel has now moved up to the major leagues. Advances in strip mill techniques have played an important part. Now, CRUCIBLE, using the best of these accepted modern techniques, plus exclusive ones of its own . . . is producing stainless by specialty steel production methods at the busy Midland Works. In the *first* mill *specifically* built for the production of stainless, top steel specialists are putting to good use $18,000,000 of new tools and buildings. When the leader in the specialty steel field applies specialty steel production methods to stainless, you can rightly expect that from CRUCIBLE you'll get the best that a half century of experience and modern tools can provide.

The new mill will produce stainless in widths of ½″ to 50″ inclusive, in all gauges, grades and finishes. This is important news to users of stainless steels, because with Trent Tube Company joining the organization, you can get stainless from Crucible in every form: sheets, strip, plates, bars, wire, forgings, castings and tubing. Crucible offers comprehensive data sheets and unsurpassed metallurgical service. Your inquiries are welcome.

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NEWS, *cont.* . . .

Co., at Texas City; and Glenn H. McCarthy, president of the company bearing his name.

Huge Coker Unit to Squeeze Hydrocarbons From Fuel Oil

General Petroleum Corp. has begun construction on a \$2.25 million refinery expansion project to turn more surplus heavy fuel oil into other

(Continued)

CONVENTION CALENDAR

National Conference on Industrial Hydraulics, fifth annual meeting, Sheraton Hotel, Chicago, October 26-27.

Technical Association of the Pulp and Paper Industry, engineering conference, Statler Hotel, Boston, October 29-November 3.

Forest Products Research Society, Northeast Section, fall meeting, Hotel Statler, New York, October 31-November 1.

American Oil Chemists Society, Edgewater Beach Hotel, Chicago, October 31-November 2.

Second Pacific Chemical Exposition and Industrial Conferences, Civic Auditorium, San Francisco, November 1-5.

Society of Chemical Industry, American Section, Chemical Industry Medal meeting, Waldorf-Astoria Hotel, New York, November 4.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, November 7-10.

American Society of Mechanical Engineers, annual meeting, Hotel Statler, New York, November 27-December 2.

American Pharmaceutical Manufacturers Association, Waldorf-Astoria Hotel, New York, November 28-30.

22nd Exposition of Chemical Industries, Grand Central Palace, New York, November 28-December 3.

Society for Experimental Stress Analysis, annual meeting, Hotel New Yorker, New York, November 30-December 2.

American Institute of Chemical Engineers, annual meeting, William Penn Hotel, Pittsburgh, Pa., December 4-7.

Synthetic Organic Chemical Manufacturers Association, annual meeting, Commodore Hotel, New York, December 7.

Society of Cosmetic Chemists, fall meeting, Savoy Plaza Hotel, New York, December 8.

American Chemical Society, Division of Industrial and Engineering Chemistry, Columbus, Ohio, December 29-30.

American Association for the Advancement of Science, Chemistry Section, annual meeting, Hotel Statler, New York, December 30-31.

First Plant Maintenance Show, Auditorium, Cleveland, January 16-19.

petroleum products in greater demand.

The project will add more than 50 percent to the ability of the company's Torrance, Calif., refinery to squeeze out the last valuable light hydrocarbons contained in the fuel oil, leaving only solid coke.

Expansion of the facilities for this secondary refining process—one for which General Petroleum already has the largest installation in the world—is particularly significant at this time.

A shift in market demands for petroleum products within the past few years has left Pacific Coast refiners with growing stocks of heavy fuel oil for which there is no apparent market.

While market demand for this product has slipped, demand for other products, such as gasoline, has risen. The paradox is that a refiner cannot make gasoline without making heavy fuel oil. The more of one he turns out, the more he gets of the other, since both are found in his raw material—crude oil.

With crude oil prices and other costs remaining high, and with reduced revenue coming in from the sale of heavy fuel, the drain on the working capital of the refining industry has been great.

General Petroleum first tackled this problem actually before it arose. In 1946 the company erected a "coker" refining unit in its Torrance refinery, capable of processing 15,000 bbl. a day. It is the largest unit of its kind in the world.

The current expansion project will increase the capacity of this unit over 50 percent and possibly as much as 80 percent.

Three years of experience in operating the present unit have shown that a barrel of heavy fuel oil fed into the coker unit will yield about 20 percent gasoline and about 50 percent gas oil, some petroleum gases that may be processed into liquefied petroleum gases ("bottled" gas), and about 85 lb. of coke. A large volume of dry gases (methane and ethane) is also produced.

The coke—over 600 tons daily—is carried away from the refinery in huge trucks—an unusual sight in an industry accustomed to having most of its products in fluid or gaseous form. It is used chiefly for the manufacture of electrodes.

The existing unit has four huge drums, each 17 ft. in diameter and 80 ft. high, lined with stainless steel. In them the heavy fuel oil is "cooked" until only solid coke remains. Addi-

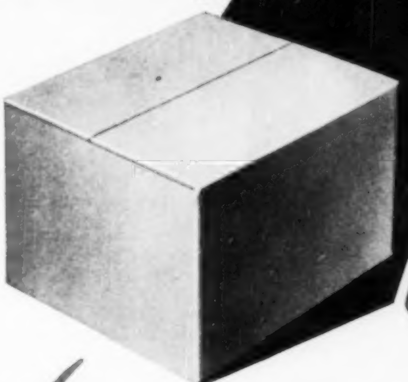
(Continued)

Gaylord Boxes

In Shipping Containers . . .

PROTECTION is the Payoff

BETTER BOXES THROUGH CONTINUING RESEARCH AND QUALITY CONTROL.



. . and you get protection-plus when you ship your product in Gaylord Boxes. The reserve strength built into Gaylord Boxes provides that extra margin of safety which is responsible for lowering damage claims and assuring factory-fresh delivery of your product.

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NEWS, cont. . .

tional components of the unit include a fractionating tower, furnaces, heat exchangers and de-coking equipment.

As a result of the expansion project, two more coke drums and another furnace will be added. Other parts of the existing unit are being revamped to permit them to handle the greater charge.

Design engineering for the expansion project is being done by M. W. Kellogg Co. Construction work will be done by Bechtel Co. Completion is scheduled for early 1950.

Cold Rubber Coming From Goodyear's Houston Plant

Cold rubber is now being made in the Houston, Tex., plant of Goodyear Synthetic Rubber Corp. The plant was originally constructed in 1943 to produce GR-S rubber. Conversion of 24 of the 48 reactors to permit manufacture of cold rubber was started a year ago.

Work was completed and regular production of the new rubber started recently. Conversion cost $675,000.

Half of the 60,000-ton annual capacity will be used to make cold rubber. The other half will continue to turn out GR-S.

Texas Plant Site Picked By Tennesee Eastman

Tennessee Eastman Corp. has announced plans for constructing a large plant at Longview, Tex. The plant site includes between 2,000 and 2,500 acres along the Sabine River on the Gregg-Harrison County boundary. President James C. White said that the new plant will produce basic raw materials needed for use in the Kingsport, Tenn., plant of the company.

This site was selected because of the nearness of raw materials such as oil and natural gas, the availability of a suitable water supply, satisfactory transportation facilities, high caliber manpower and good living conditions.

Local sources indicate the first unit will cost approximately $1.5 million.

Staley Adds New Plant for Soybean Oil Extraction

A. E. Staley Mfg. Co. has started construction of a new soybean oil extraction plant at Decatur, Ill., as part of a program for modernizing its processing facilities. The building is to be completed next July.

An addition will also be built on the

(Continued)

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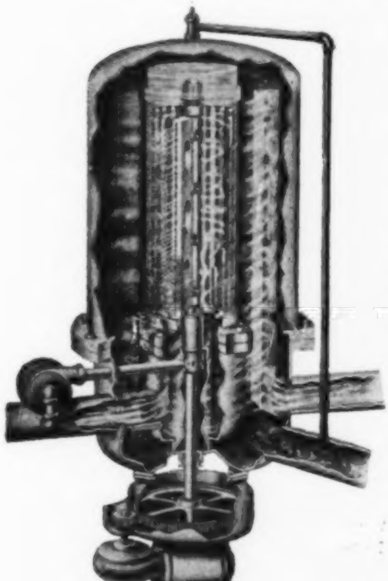
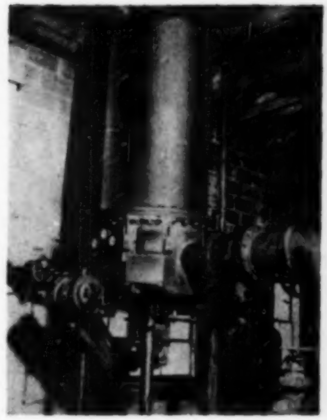
Whether water for mill use is scarce (as in many communities) or comes, trash-filled, from river or lake . . . a Cuno FLO-KLEAN makes it do more work, cleaning it for use and re-use, with trifling water loss.

FLO-KLEAN at the Quaker State Oil Refining Corp. removes unwanted solids from river water to be used in heat exchangers and process work. Spacing .015 in.*. Filter handles 2400 gpm at 45 psi, with only 3 psi drop across the filter. (Other models handle up to 8000 gpm).





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Filter element consists of cylindrical cage, threaded and wound with round wire. Space between wire* allows fluid to flow inward, but stops all contaminants larger than spacing. Pressure drop is exceptionally low because fluid moves in a straight line, encountering only momentary restriction.

*Available spacing from .0025 in. to .020 in.

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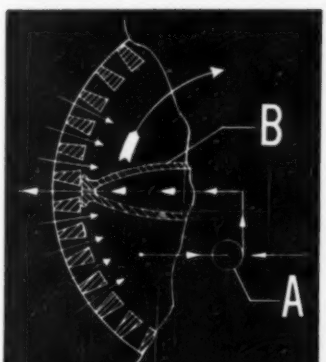

Recirculating pump (A) returns small proportion of filtered fluid into system under elevated pressure through rotating nozzle (B) cleaning slots and restoring free area. There is no loss of backwash fluid; no interruption of flow; no need for duplex installation. Operation, including sludge removal, may be completely automatic.

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preparation building, where soybeans are made ready to go through the extraction process, and the underground storage for hexane, which is used to extract the oil from the flaked beans, will be expanded.

The new plant, which will have a rated daily capacity of 800 tons of soybeans, will be adjacent to the first plant, which has a rated capacity of 500 tons. It is estimated that the cost will be more than the $2.5 million spent on the first soybean extraction plant completed four years ago.

Operation of the company's expeller plant will be continued for as long as possible, according to A. E. Staley, Jr., president. Conversion of the company's entire soybean processing operations to the extraction method will not increase the plant's overall capacity, but will make it possible for Staley to discontinue use of a less efficient process.

"The difference between the old and the new methods may well be the difference between full or partial employment, and profit or loss," according to Staley. "We are using some of our savings to make this move now, so as to keep the company in a favorable competitive position."

The construction contract has been awarded to H. K. Ferguson Co., Cleveland, Ohio. A contract had previously been awarded to Blaw-Knox Co. for engineering work on the new building and for supplying the principal machinery. The contract for installation of machinery is not yet awarded.

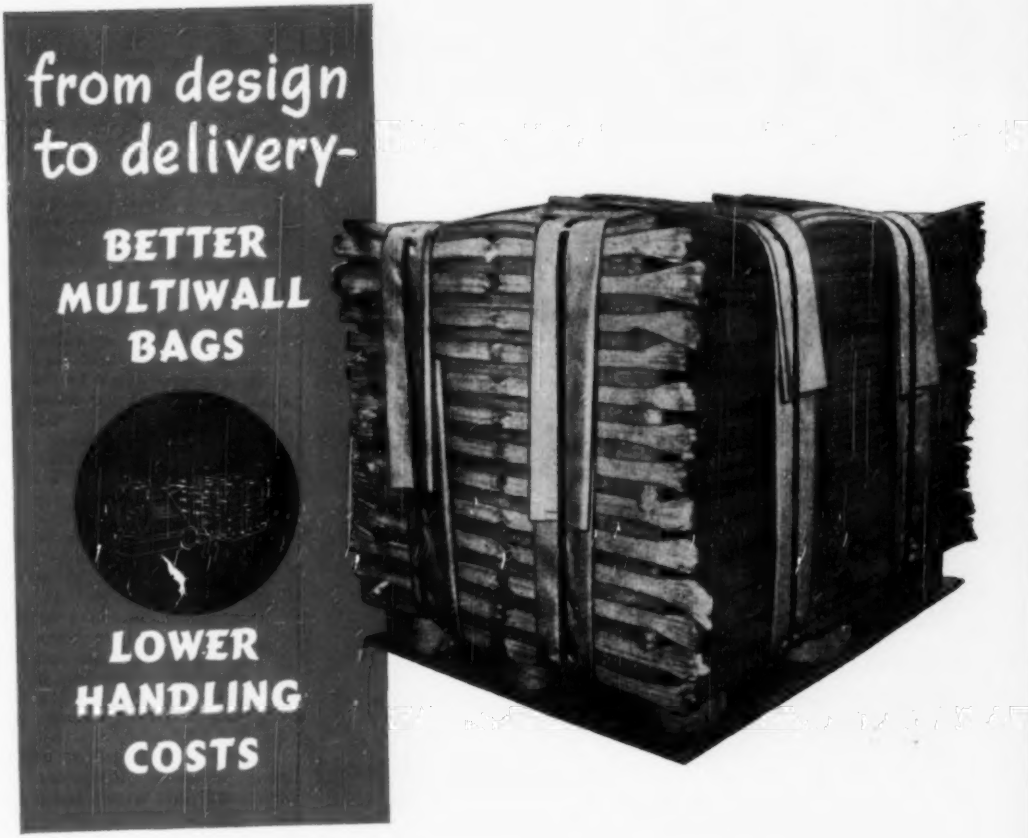
Mississippi Attracting Chemical Industries

Chemical enterprise in Mississippi is booming. More chemical companies, and bigger ones, are moving into Mississippi all the time. This in a state whose industry was until recently based largely on her cotton and timber resources.

Although discovery of oil in Mississippi in 1939 brought in a number of petroleum companies, the state at present is witnessing the construction of three chemical plants which together will cost close to $30 million but which are not related to petroleum.

They are: (1) International Paper Co.'s $20 million rayon pulp mill at Natchez, which was started this year; (2) The Mississippi Chemical Corp.'s $8 million anhydrous ammonia plant at Yazoo City, on which foundation

(Continued)



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tests are being made; and (3) the acquisition by the community of Cleveland in June of the Baxter Laboratories, Inc., manufacturer of intravenous solutions and hospital administration sets, with headquarters in Morton Grove, Ill.

Bond issues, voted by local citizens under Mississippi's "balance agriculture with industry" act, were made available to each of these new industries. Under this law, known as BAWI, districts and communities in Mississippi may secure permission from the Mississippi Agricultural and Industrial Board to hold bond elections to provide funds for the purchase of sites and the construction of buildings to house new industries.

In addition to these latest acquisitions for Mississippi, the state today boasts 22 other chemical firms, exclusive of its 16 fertilizer plants and 40 cotton oil mills.

One of the largest enterprises in the petroleum field is the \$5 million recycling plant that the California Co. located near Natchez in 1948.

Two growing refineries of the Southland Oil Co., one at Yazoo City turning out gasoline and motor oils and the other at Heidelberg in south Mississippi processing asphalt and fuel oils, have been established within the past 10 years.

Since Mississippi leads the nation in tung production, many small but prosperous paint manufacturing plants are springing up throughout the southern part of the state, where tung production is high and there are mills to crush the nuts.

Behind this influx of chemical process industries are: (1) access to local markets; (2) available low-cost power; (3) abundant natural gas; and (4) numerous raw materials.

The new rayon pulp mill of International Paper, for example, will utilize Mississippi's soft and hard woods in making its product. Others drawing on the state's timber resources includes Hercules Powder Co. at Hattiesburg, Gulf Naval Stores at Gulfport and the Dixie Pine Products Co. at Hattiesburg.

In the drug field, not only is there the medical supplies business of Baxter Laboratories but also the \$1 million Phillips' Milk of Magnesia plant at Gulfport, which was established early in 1948.

Insecticides, deodorants, soaps and cleaning compounds are being made at Jackson by the Magnolia Chemical Co.; tooth paste is being manufactured on a small scale by the Iodine Products Co. of Gulfport; and F. W.

(Continued)

NEWS, *cont. . .*

Fitch Co. has a big modern plant recently put up in Jackson for the manufacture of cosmetics.

Two firms, the Tri-State Linen White Co. and the Rotox Chemical Co., both of Jackson, make bleaching solutions.

Bentonite from Smith County, in South Mississippi, is being used by the Filtrol Corp. of Jackson in the manufacture of acid-washed bleaching clay.

Professor To Streamline Oldest Texas Lime Plant

A member of the chemical engineering faculty at the University of Texas in Austin, W. A. Cunningham, and 16 of his associates have purchased the Round Rock White Lime Co. The plant is located at Round Rock, Tex., made famous by the outlaw Sam Bass.

This lime plant was established in 1872 and has produced continuously since that time. It is the oldest chemical process industry plant in Texas. The site was chosen because it affords a supply of the purest limestone (better than 99 percent calcium carbonate) in the state.

Heretofore the plant has been hand-operated throughout, even to crushing the limestone by sledge hammers. The new owners will modernize the plant and convert it from burning lignite to natural gas. Top quality lime will be produced for water treatment and other chemical uses.

Briefs . . .

Ethyl Corp., now in full-scale production of benzene hexachloride at its Baton Rouge, La., plant, will almost double its capacity by this fall. Already, Ethyl Corp. is the second largest producer, with Commercial Solvents the only bigger producer of hexachloride. Contract prices on the insecticide material are quoted by Ethyl Corp. on a gamma-unit basis.

Du Pont expects to put its new plant for the production of Orlon acrylic fiber into production late in 1950. The Camden, S. C., plant, first of its kind in the world, has been named in honor of Benjamin M. May, retired head of Du Pont's Rayon Department.

Pan-Am Southern Corp. is the name of the organization that results from the merger, effective September 1, of Pan American Petroleum Corp. and Root Petroleum Co. Head-

(Continued)

quarters of the new corporation, a subsidiary of Standard Oil Co. (Indiana), will be in New Orleans.

General Electric Co. is setting up a third operating unit in its Chemical Dept. to handle booming business in laminated plastics. The new Laminated & Insulating Products Division will be managed by Harry K. Collins, who has been manager of the Plastics Division.

Texas Chemical & Supply Corp. has just been formed to distribute industrial chemicals and building maintenance supplies throughout Texas. E. H. Wyckoff, formerly of Diamond Alkali, is vice president and general manager. The firm, located in Houston, will handle cleaning compounds, detergents and heavy chemicals.

Corn Products Refining Co. is now running tests on the recently completed sugar refiner, final unit of its $25 million Bluebonnet plant at Corpus Christi, Tex. This plant, the only one of Corn Products to use sorghum grains exclusively, will be formally opened this fall.

READERS' VIEWS AND COMMENTS

Error

To the Editor:

Sir:—I read with considerable interest the article on "Design of Thick Walled Pressure Vessel Shells" which appeared in your August issue.

I would like to call the attention of the authors to an error which appears in connection with Fig. 3 (p. 125). The authors develop Eq. 9 for the membrane analysis in which the pressure is a function of working stress and the parameter t/D_i and Eq. 10 for the Lame analysis which is also a function of working stress and t/D_i. They then state that "Fig. 3 shows the percentage difference between the two formulas based on the use of a material with an allowable working stress of 13,750 psi."

If one determines the error between the pressure as given by the membrane formula and the Lame formula as follows, it develops that the error is independent of the allowable working stress and is a function of the parameter t/D_i alone.

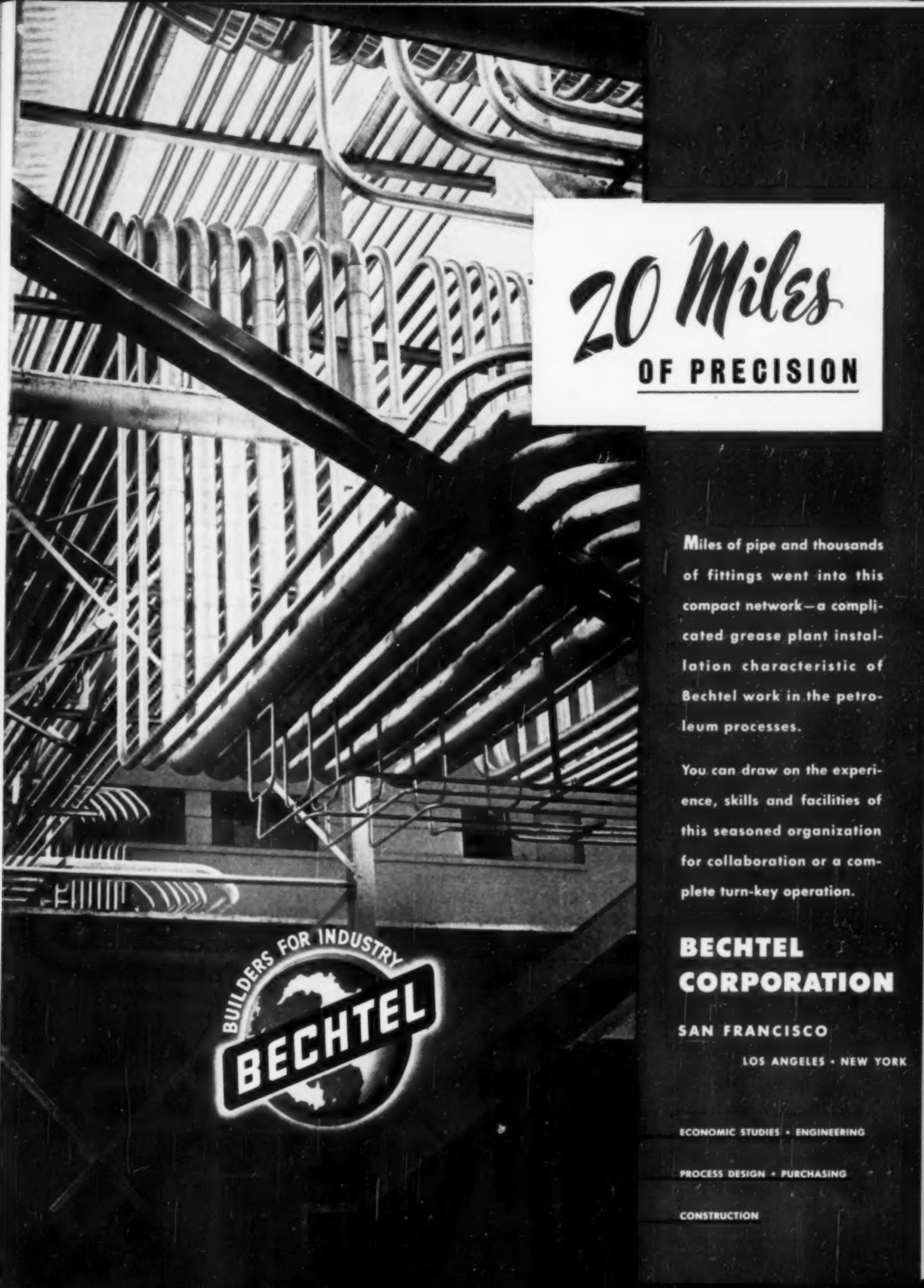
Membrane formula

Let $P_M = 2S_w\,(t/D_i)$

Lame formula

$P_L = S_w\,[(t/D_i)^2 + (t/D_i)]/[(t/D_i)^2 + (t/D_i) + 1/2]$

(*Continued*)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READERS' VIEWS, cont. . .

The error e, in percent, is

$$e = 100\,(P_M - P_L)/P_L$$

Performing the necessary operations, S_w cancels out and the percent error becomes

$$e = 100\,[2(t/D_1)^2 + (t/D_1)]/[(t/D_1) + 1]$$

HAROLD RIND
Liquefaction Division
Air Reduction Sales Co.
Jersey City 4, N. J.

Correction

To the Editor:

Sir:—With reference to Fig. 3, the authors wish to correct the inference that the percentage error is dependent upon the allowable working stress. If the same stress value is used in both the membrane and Lame formula, the percentage error is independent of the value of S_w, since percentage error is only a function of parameter t/D. The statement that materials with different allowable working stresses will vary the percentage error slightly, is erroneous.

It was the intent to state that the total error, which designers are primarily interested in, is a function of the allowable working stress.

R. R. MACCARY
Process Industries Engineers Inc.
Pittsburgh, Pa.

He's Bigger Than Me

To the Editor:

Sir:—I have just finished with a great deal of interest *Chemical Engineering* for the month of August, and particularly the article on the Du Pont suit (p. 189).

Last spring State Senator Maytag of Newton, Iowa, who is the principle owner and president of the Maytag Washing Machine, gave a talk to the Iowa Engineering Society, and in his talk he dealt with big business and the definition of big business.

He stated he had given the matter a great deal of study, thought, and attention, and had read everything he could find on the subject, and perhaps this might help out Attorney General Clark.

State Senator Maytag stated that after long study of the subject he had finally arrived at a definition, namely, that "any business was big that was bigger than his business." This interesting comment, I believe, is just about what this subject finally settles down. "Anything is big that is bigger than I am."

JOHN M. DRABELLE
Iowa Electric Light and Power Co.
Cedar Rapids, Iowa

—*End*

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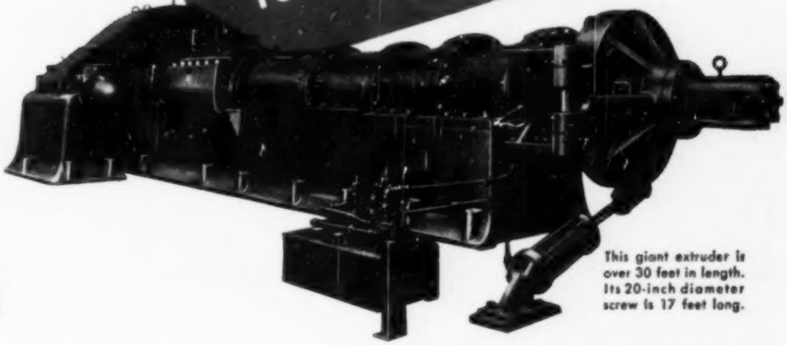
THE LARGEST EXTRUDER EVER BUILT FOR WORKING PLASTICS



This giant extruder is over 30 feet in length. Its 20-inch diameter screw is 17 feet long.

This giant in the standard series of Farrel-Birmingham extruders is over 30 feet long, and the screw contained in the five-section cylinder is 20 inches in diameter and 17 feet in length.

The machine receives raw material in a continuous flow through a rectangular hopper in the first cylinder section. From here the stock is worked and forced forward by the screw through a perforated plate before passing through the downward discharge die.

Both screw and cylinder are hard-surfaced and cored for the circulation of temperature-controlling fluid. The swinging die head has a hydraulically operated bayonet-type lock. The overall construction, which combines the use of Meehanite metal and steel, is extremely heavy and rugged to permit high-pressure operation.

Farrel-Birmingham extruders are available in 6", 8½", 12", 15" and 20" screw diameter sizes for processing rubber and plastics. *Write for complete information.*

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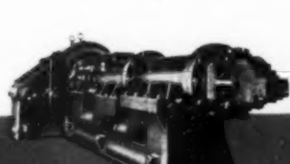
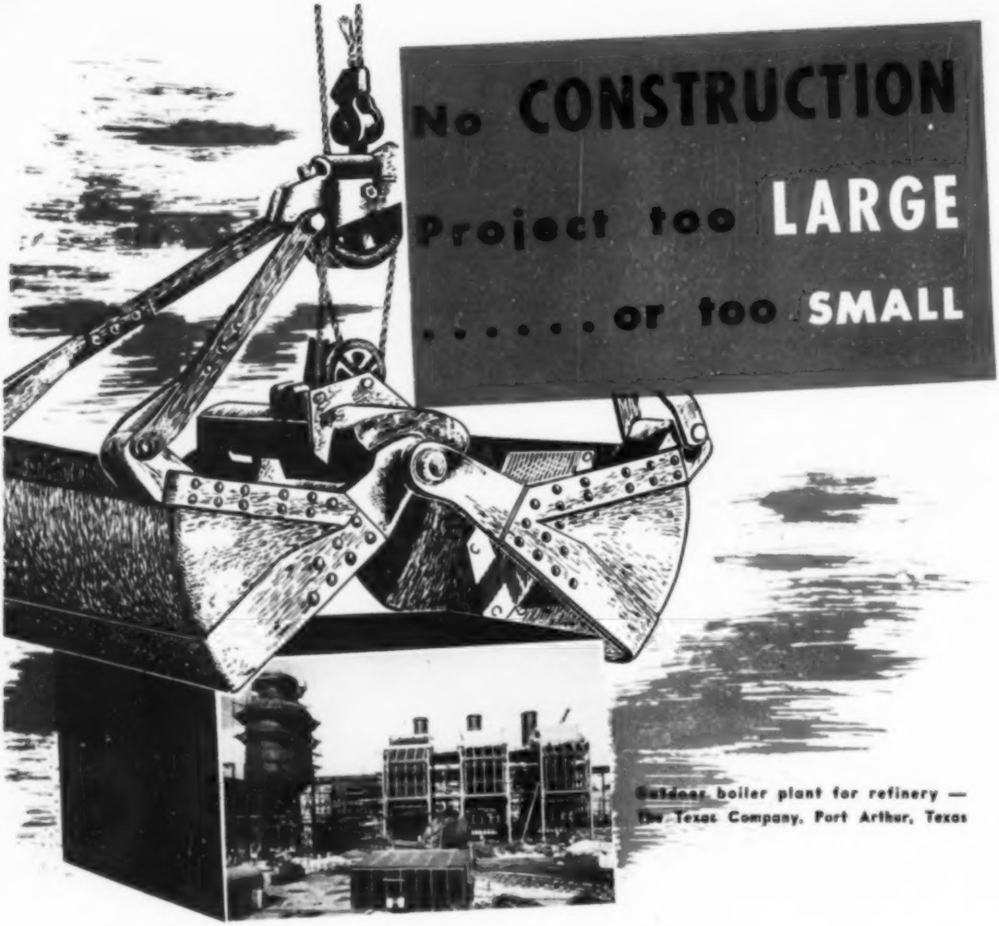


8½" extruder for working plastics.

Farrel-Birmingham



Outdoor boiler plant for refinery — The Texas Company, Port Arthur, Texas

To the chemical and process industry, Merritt-Chapman & Scott Corporation offers a construction service based upon years of experience in the building and equipping of pharmaceutical and chemical plants, pulp and paper mills, food processing establishments, rock products installations and metallurgical plants. A large part of this work has included the installation of mechanical equipment, piping, and processing facilities.

To the company official, consultant, works executive, or plant engineer, Merritt-Chapman & Scott offers, not only wide experience in serving the chemical process industry, but the resourcefulness of skilled personnel and extraordinary construction facilities to speed the construction of your new plant or addition.

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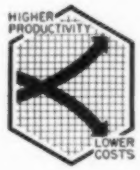
Men, Machines and Methods

ROGER WILLIAMS, JR., Assistant Editor



Labor Productivity Can Be Raised, and Labor Unions Will Help if Approached Properly

Since a great portion of this issue is being devoted to cost reduction, we had better follow along. But we will limit ourselves to just one phase—cutting costs by increasing labor productivity.

Labor productivity has been much in the news recently. When the steel companies and the CIO were presenting their cases to the President's fact finding board, they got into a heated discussion of the question.

But labor productivity is simple—whether you are dealing with steel or methanol or zippers. It is merely the number of units produced, divided by the total number of man hours used. The catch is to decide what is good productivity, and what is bad.

No matter what the existing productivity of a plant is, it can always be improved. The problem, here, is to find the best way of doing it. With an assembly line, you can speed up—as UAW so often tells us. But how can the operator of a methanol converter "speed up?" In general, he can't.

Where a chemical plant is concerned there are four kinds of labor to be considered: operating labor, maintenance labor, construction labor, and overhead labor. Those four categories cover everyone from the labor gang and the office boy to the chairman of the board. We want to discuss each of them briefly.

In an existing plant, it is hard to reduce the number of operators required. For one thing, the layout of the plant when it was built dictates operators required, usually. New equipment and instrumentation can be added, but unions will not like it if it means men are laid off. Any union man will tell you he is all for "technological advance" if it means more pay for him for equal or less work. But he'll yell bloody murder if the "technological advance" means his job.

The way to cut labor requirements by introducing new equipment is to make sure that no one is laid off. This can be done in two ways. First, let normal turnover take care of it. Just don't hire replacements. Most unions will go along with this if it is explained to them. The other way assumes that your plant is expanding. Keep the men involved and use them in new units as they are built.

Unions can be helpful or harmful. Here are some excerpts from union contracts, quoted by the Department of Labor (Bulletin No. 908-10). First the ones that guarantee management's rights to technological improvements:

"It is further agreed that the employer shall have the right to install in its factory or factories during the life of this agreement any modern machinery or equipment that it may desire."

". . . the right to use improved equipment or methods shall remain with the company."

"The arbitrator shall not render decisions on the right of the company to initiate technological changes which have been initiated in accordance with the provisions of this agreement."

UNIONS CAN FIGHT CHANGES

But don't kid yourself that there aren't unions on the other side. Sometimes unions demand participation in any proposed changes. Sometimes they want to prohibit technological changes entirely.

Here are the provisions of one agreement: "The (employer) agrees that it will not, during the life of this agreement, introduce any new processes, equipment, or machinery used as an evolution of or substitute for current . . . processes, equipment, or machinery without consent of both parties hereto, but should any strike or similar work stoppage occur during the terms of this agreement the (employer) may cancel this contract and the above obligation as regards new processes, equipment, or machinery, shall thereupon cease."

"No labor-saving machinery shall be put into permanent operation until the union and the company have mutually agreed to the wages, hours, and working conditions pertaining to the particular device to be installed."

In dealing with operating labor, there are a couple of hidden efficiency things that are worth considering. They deal, however, with plants that are runnning 24 hours a day, 7 days a week.

The first one to consider is vacation scheduling. We can remember one plant that plotted the number of vacations taken each week during the year. The summer peak amazed them. Then they began to figure how many unnecessary vacation relief men they had to carry during the off-peak months. The next year that company put on an organized program to iron out the summer peak. They were amazed at the cooperative reception. The result: a real dollar saving. You might try it yourself when vacations are scheduled at the end of this year.

Another thing to watch is absenteeism. The payroll people can often supply a daily absenteeism figure. Plotting it can give some interesting results. Compare the peaks with the opening of hunting and fishing seasons. Experience in some plants would indicate you can forecast absenteeism—hence plan for it. Here again some check-ups by the medical staff can cut down the false sickness claims. Most union will actively help.

Some union contracts even specify that the union will help. Here is one quoted by the Dept. of Labor: "The union agrees to cooperate with the company and support the company's efforts to assure a full day's work on the part of employees whom it represents, and to combat actively absenteeism and other practices which curtail production. . . ."

Maintenance labor is a fertile field for cost cutting—and there are several ways of doing it. One of the best is scheduling. Good scheduling of the day's work for a maintenance crew can save hundreds of man hours a month, get more work out of your craftsmen, yet not overwork them. It just means

(Continued)

more of their time will be productive, less just going from one job to another. The job is to balance cost savings in maintenance with perhaps more outage of equipment needing repair.

Another fertile field in maintenance costs is standardization of jobs and equipment. Take the average plant and check the number of different makes of 50 gpm., 150 ft. head pumps. There may be a dozen or more—all requiring different types of packing or seals to be kept in stock. Mechanics have to remember the idiosyncracies of each of the dozen types. Foresight in purchasing for new plants can mean a real saving. Here is a situation where buying the pump with the cheapest quotation may mean paying and paying and paying in the future. Concentrate on a given type of equipment where possible in the different units of your plant. It will pay off in the long run. Try it and see.

CRAFT UNIONS A PROBLEM

Well, let's turn to construction labor. Here is where any company bumps up against the long-established craft unions. So perhaps a story will illustrate the problems, and also the reasonableness of these unions. Down south, one company was building a new plant and putting up brick buildings. They found that the bricklayers had decided to lay just 200 bricks a day—no more, no less. At the wage rate involved, that made brick buildings expensive, to say the least. The company figured out that poured concrete would be cheaper unless the bricklayers could lay 800 bricks a day. The situation was put up to the bricklayers. Result: 800 bricks were laid a day.

Although, as the above indicates, craft unions can be reasonable, these unions seem to resent technological changes. The painters are well known for this. One contract puts it this way: "Employer agrees that the use by an employee of a spray machine or gun with oil paint, or that dipping in oil paint or any other method shall be prohibited." We aren't sure about those three words "any other method." That would seem to indicate you couldn't even use paint brushes, but we'll bet the union didn't mean that.

We know this is only a brief survey of what can be done about labor productivity. But we cannot close without mentioning overhead labor. There is perhaps no better place to look for places to cut costs. Companies are just as liable to bureaucracy as governments. So a real study can show impressive savings. —End

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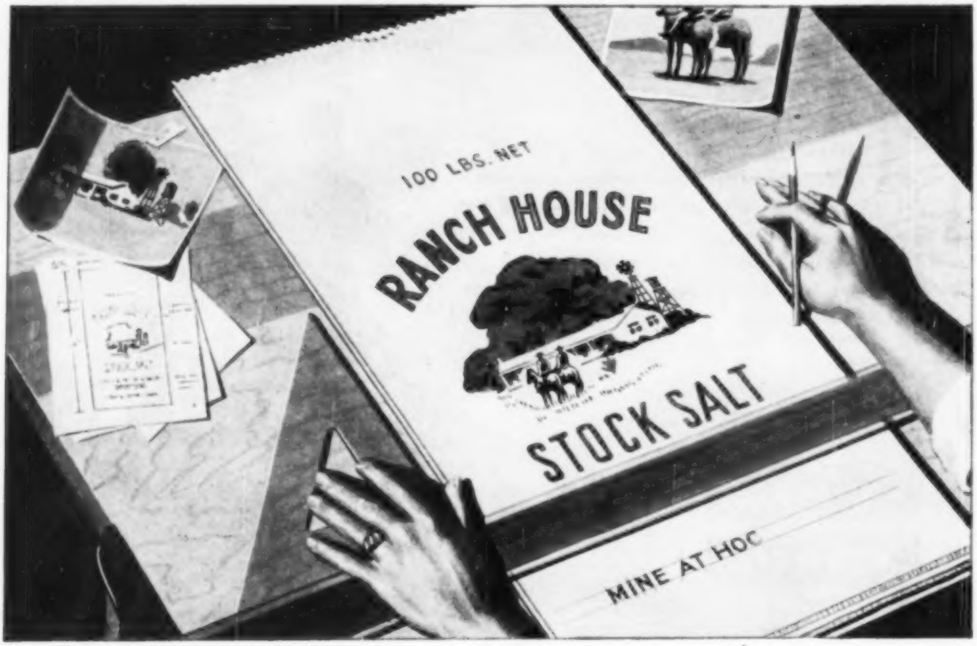

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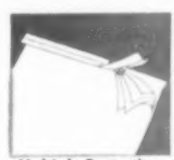

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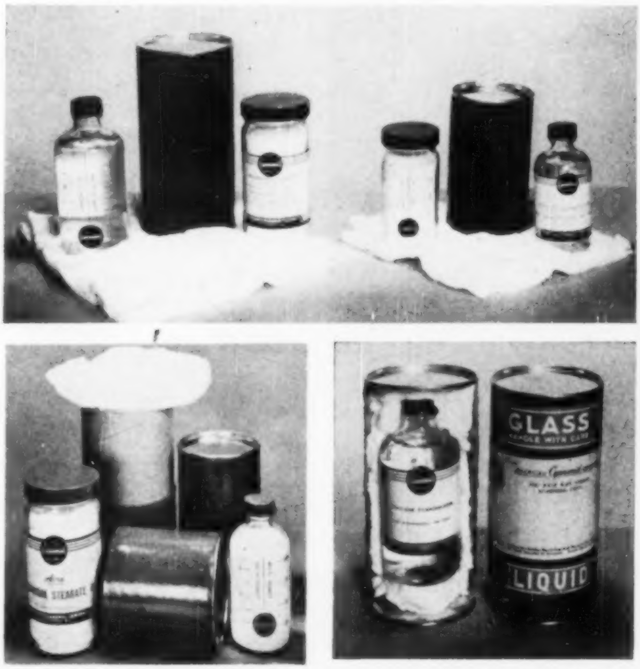


Standardized containers carry shipments of samples to Cyanamid customers. Bottles are graduated and packing will absorb liquid in case of breakage.

Sample Containers Combine Safety and Sales Appeal

Shipment of a sample of a product presents an opportunity to the manufacturer to impress the prospective customer with the quality of his products and the efficiency, reliability and cooperative spirit of the company. American Cyanamid Co. has spent over two years in developing a container for samples that takes full advantage of these opportunities.

Wide mouth glass jars for dry materials and narrow mouth bottles for liquids are closed with screw caps molded of blue Beetle resin. Liners for these caps are carefuly tested before shipments are authorized to make certain that there are no possibilities of contaminating the samples. The label, printed in the same blue color, contains necessary technical data about the sample as well as cautions to be observed in the event the compound is hazardous. The outer shipping container is a spiral wound metal end telescope top fiber can lined with a glossy blue wrapper. The bottle is cushioned with sufficient Kimpak to absorb the contents of the container in the event of breakage.

The unique and distinctive feature of this bottle is that it can be used as a graduate both in dispensing the original contents and in reusing the bottle in the laboratory. Graduations in both fluid ounces and cubic centimeters are fused into the glass with an ink that cannot be removed by the ordinary alkaline or acid rinses commonly used for washing laboratory ware. Thus, the use of the sample is made easy and the container has a lasting use in the customer's laboratory.

Freight Forwarders Speed Smaller Shipments

The service that freight forwarders render to shippers includes pickup of shipments, consolidation into full carload or truckload lots, transportation by rail, truck or water and upon arrival of the merchandise at destination delivery to consignee's place of business. This is accomplished by using not only their own trucking fleets in large centers but by contracting with local truckers in smaller communities and by use of rail and water transportation.

Some forwarders operate only in certain sections of the country, others handle the shipments of certain industries while still others concentrate on export shipments. They provide a through transportation service, issuing their own bills of lading, settling claims often before compensation is received from the responsible carrier, tracing shipments and billing the shipper even if several transportation services are used. Actually they assume full responsibility for shipments.

The shipper pays the less carload rate and the forwarder through his ability to consolidate shipments pays the carload rate and this difference in the rates is the forwarder's compensation for his services. Rates are filed with the ICC.

Freight forwarders through their facilities and knowledge of transportation conditions are able to speed up deliveries. They use merchandise trains which operate at high speeds on regular schedules. There are over 200 of these trains operating between Chicago and St. Louis, New York and Cleveland, Los Angeles and San Francisco, etc.

Often special equipment is used and special handling techniques developed for efficient movement of special types of merchandise. They make use of pallets and skids; road truck are sometimes equipped with elevating tail gates.

There are certain advantages that shippers may derive from these services. Deliveries may thus be speeded up to the point that express, postal and even air shipments can be dispensed with. C.O.D. service is available, the forwarder remits direct to the shipper without awaiting collec-

(Continued)

tion from the consignee. The flexibility of this type of service is such that deliveries can be made at times that are convenient for consignees. Also, simultaneous deliveries can be made at many receiving points.

Construction Materials for Tank Car Valves

The material specification for trim on safety valves, angle valves, check valves and sampling line valves used on pressure tank cars, listed by commodity, are as follows:

Stainless Steel[1]

Acrylonitrile
Alcohols with high vapor pressures
Acetaldehyde
Acetone
Ethyl Chloride
Vinyl Chloride
Ethylene Oxide
Ethylene Chloride
Fertilizer Ammoniating Solution
Methyl Bromide
Methyl Chloride
Motor Fuel Antiknock Compound
Sodium, Metallic
Tetraethyl Lead
Tin Tetrachloride, Anhydrous
Ammonia (Anhydrous)
Nitrosyl Chloride
Propane
Carbon Dioxide (liquid)
Sulphur Dioxide (liquid)
Sulphur Trioxide

Monel Metal[2]

Hydrofluoric Acid, Anhydrous
Chlorine (liquid)[4]

Nickel[3]

Bromine (liquid)

[1] A.I.S.I. Type 304. Free machining Type 303 grade and hardenable grade Stainless W may be substituted where service conditions and fabrication procedures make it advisable. Type 303 and Stainless W, in general, have somewhat inferior corrosion resistance to that of Type 304. [2] The hardenable grade K Monel may be substituted where it seems advisable. Hastelloy C may be substituted for parts exposed to wet, severe corrosive conditions. [3] Hastelloy C may be substituted. [4] Chlorine Institute Standard.

When materials other than those listed are specified as trim, they are to be considered as special fittings.

Stamping Identification

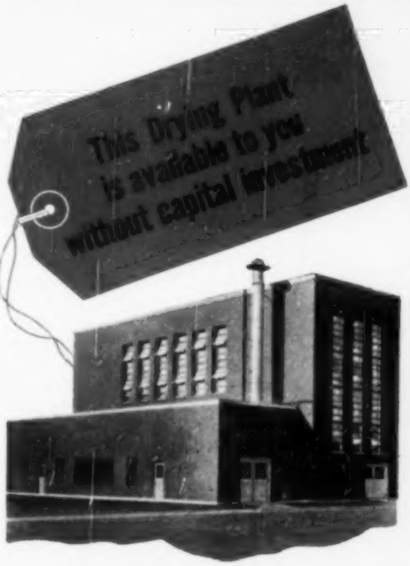
Material	Identification
Plain Carbon Steel	STL
Stainless Steel	AISI Type numbers such as 304, 303, 416, etc.
Monel	M
Nickel	Ni
Inconel	I
Hastelloy	H- c

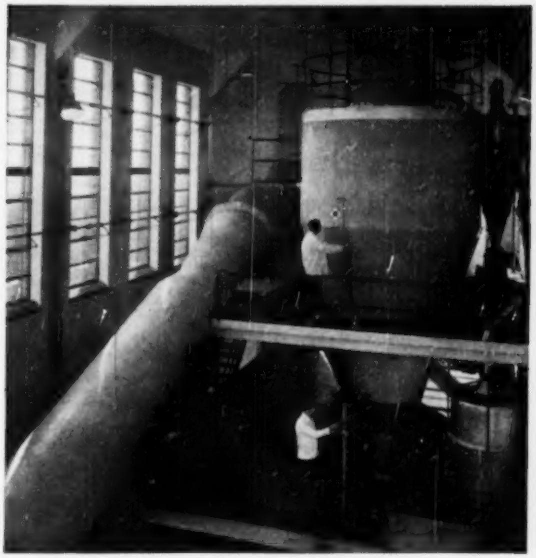
The Tank Car Committee of the M.C.A. in cooperation with tank car builders has prepared the above table of recommended materials of fabrication for valves for high pressure tank cars.

Duraglas Research Center

It is the avowed purpose of the Owens Illinois glass container research center at Toledo, Ohio, to make the use of their products more practical, more economical, and more profitable for their customers. The facilities of the laboratory are freely offered to

(Continued)


This Drying Plant
is available to you
without capital investment



their customers for solving glass container problems.

The services include developing new shapes for specific uses and even designing of labels, shelf boxes and shipping cases. Caps and liners for bottles and jars are chosen from results of standardized tests. The group is equipped to design conveying, bottling and capping equipment if standard machinery is not available.

The laboratory regularly determines the strength characteristics of their ware by a variety of tests which includes hydrostatic, hydrodynamic, impact, and several types of rough handling tests as well as by polariscopic examination. The ability of shipping containers to protect glass bottles from transportation and handling abuses is determined by such standard tests as dropping, revolving drum, Conbur impact, compression, and vibration.

This laboratory is well equipped both as to skilled personnel and equipment to solve problems of packaging in glass.

Paper Bags on Paper Pallet

International Paper Co. palletizes multiwall paper shipping sacks to reduce handling costs. They use four way entry, expendable paper pallets. Bags are secured to pallets with steel strapping and where required the unit load is covered with kraft paper to prevent soiling.

Briefs . . . . . .

William B. Carter has joined the MCA Washington office staff as assistant to the Secretary. He is a graduate of Vanderbilt University with 14 years of engineering experience in the chemical industry. Mr. Carter's duties will include technical committee and statistical work.

—*End*

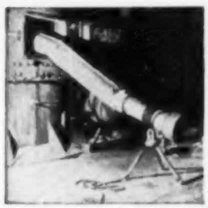
COPPUS "BLUE RIBBON" VENTILATORS

identified by the blue band

FOR WORKERS'

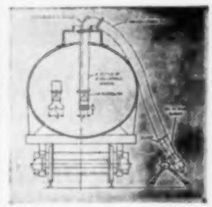
- *Safety*
- *Health*
- *Comfort*
- *Efficiency*

VANO Design "A" VENTILATOR

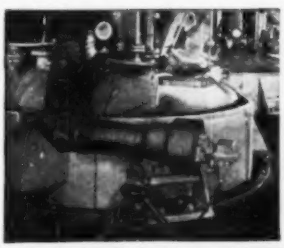


Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.



Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.



Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½ hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ...or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ...or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½ hp motor, it weighs only 85 lbs.

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Please send information on the Blowers that clear the air for Action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.
- COOLING:
- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

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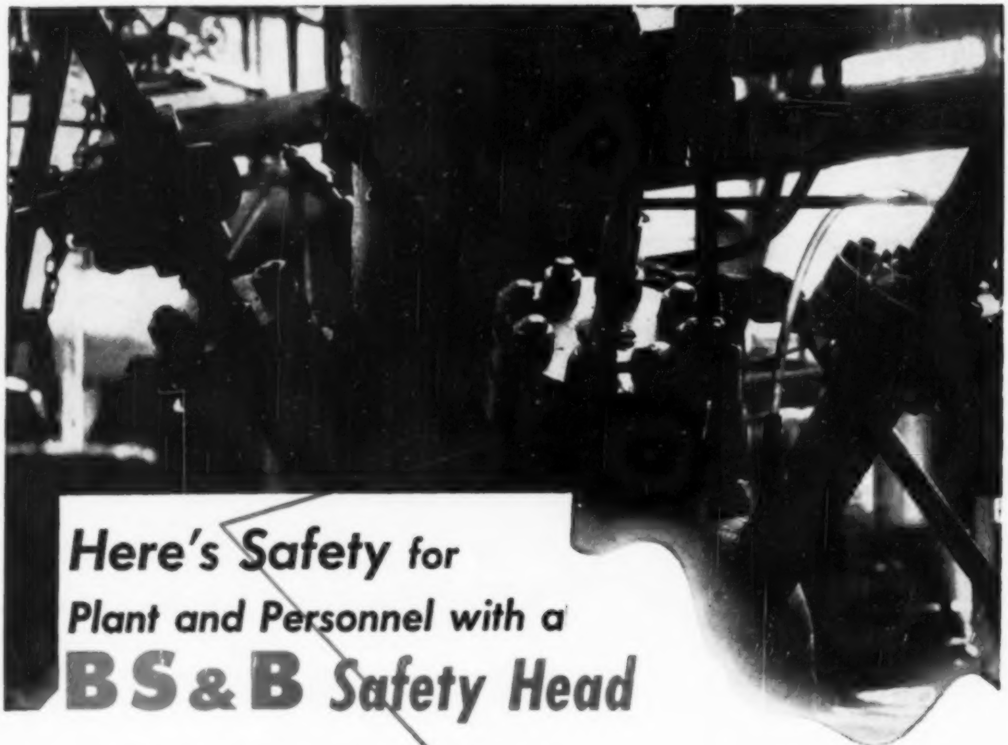
COMPANY ....

ADDRESS ....

CITY ....

(Write here any special ventilating problem you may have.)

COPPUS "BLUE RIBBON" PRODUCTS—*Designed for Your Industry, Engineered for You*

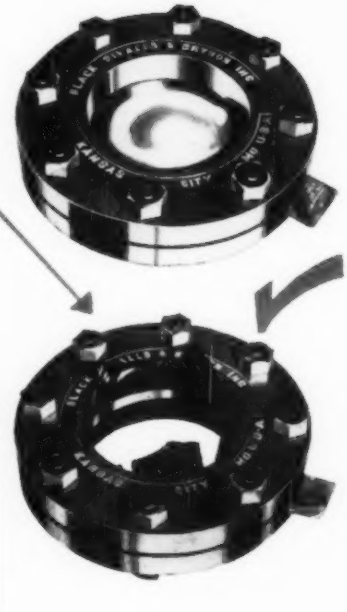


Here's Safety for Plant and Personnel with a BS&B Safety Head

The Black, Sivalls & Bryson SAFETY HEAD is a pressure relief device consisting of a pre-formed metal rupture disc, held between specially designed base and holddown flanges.

The SAFETY HEAD rupture disc bursts at pre-determined pressure and temperature, affording instant, full-diameter relief. The burst rupture disc is quickly and easily replaced with a new one, and the SAFETY HEAD continues to serve you in its capacity of "watchman" over the well-being of your personnel and the security of your plant and equipment.

For further information, write to Special Products Division, Black, Sivalls & Bryson, Inc., Power & Light Bldg., Kansas City 6, Mo. Use coupon below:



BS&B SAFETY HEADS

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I'd like full details of the BS&B Safety Heads.

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News From Abroad

SPECIAL CORRESPONDENCE

New Oil Refinery to Be Built in Puerto Rico

San Juan—Lyford and Eberle, construction engineers, New York, will construct the first oil refinery near the city of Ponce, Puerto Rico, with an annual capacity of 25,000 bbl., costing approximately $20,000,000.

The new refinery will be operated by The Puerto Rico Oil Refining Co., a new corporation with offices at Ponce. Crude oil will be imported from Venezuela and other Caribbean oil producing countries. Parsons, Brinckerhoff, Hall and McDonald, of New York will be in charge of the engineering works of this project.

The new corporation registered at the Executive Secretary's office in San Juan, is composed of the following officials: Raul Roig, Pedro Luis Vivas, and Jose Gullermo Vivas, all of Ponce.

Pakistan May Make Paper From Native Bamboo

Karachi—Swedish and Canadian consultants have been retained by the Dominion government to prepare a project survey covering the establishment of a 100-ton-a-day paper mill at Karachi, Pakistan, based on the vast bamboo jungles of the Chittagong Hill Tracts of Eastern Pakistan.

Preliminary studies indicate such a plant could be put into operation at a cost of about $18,000,000 within three years from finalization of specifications. At present Pakistan has no indigenous paper industry.

Royal Dutch New Plants Opened in Holland

Amsterdam—The Royal Dutch synthetic soap and plastics factories at Pernis near Rotterdam, Holland, were officially opened on September 2. The entire Pernis plant, including its refinery, occupies an area of 1,200 acres. In the postwar expansion of the refinery and the building of the two factories the company has invested $64,600,000-$76,000,000. Tank installations have a capacity of 1,000,000 tons, and another 400,000 tons are under construction.

Further expansion, due for completion by 1952, includes: a distillation unit of 6,000 tons a day; a vacuum distillation; a large catalytic cracking installation; a reforming unit; and two polymerisators. The expansion program is already under way.

Australia Will Have New Plant for Plastics

Sydney—At a recent meeting to discuss the advisability of placing an import duty on shipments of plastics into Australia, it was announced that a £ A 2,000,000 project to manufacture plastics in Australia is planned by the Colonial Sugar Refinery Chemicals Ltd. The only detailed information given was that the company was a subsidiary of the Colonial Sugar Refinery Co., Ltd.; that £90,000 already has been spent on preliminary work; and that so far as possible, the plastics would be made from native raw materials.

Imperial Oil Co. Seeks To Extend Pipeline

Ottawa—A large portion of Alberta oil may be refined and consumed in Ontario instead of the United States, according to an application of Imperial Oil Co., Ltd., which will be heard here soon before the Board of Transport Commissioners, with the Imperial Oil seeking approval of its application for continuation of its $100,000,000 pipeline from Regina to Gretna, Manitoba. Already the board has approved building of the first stage of the pipeline from Edmonton to Regina.

It is understood here that instead of the Imperial Oil shipping direct to the U. S. in a swap for U. S. oil from Illinois and mid-continent fields to Sarnia, that Imperial Oil's Alberta crude oil will be piped to Gretna, then shipped to Duluth, Minn., for transshipment to Sarnia on the Great Lakes.

McGRAW-HILL World News

Interchemical Corp. Will Aid Australian Firm

Melbourne—A local firm, Sidney Cooke Ltd., has entered into an agreement with Interchemical Corp., New York, under which a subsidiary company will be incorporated in Australia to manufacture under license the complete range of specialty printing inks made by the American concern. The company will operate as Sidney Cooke (Printing Inks) Pty. Ltd.

Interchemical is a manufacturer of chemical coatings for protective and decorative purposes. It will make available to the new Australian firm its technical know-how and share with it the fruits of future research.

Haifa Has Fertilizer Plant in Operation

Israel will reduce its imports of fertilizers and basic chemicals by millions of dollars annually through a new company recently established near Haifa, the only one of its kind in the country, according to Robert Szold, board chairman of the Palestine Economic Corp., American development company operating in Israel.

The firm, Fertilizers and Chemicals, Ltd., in which the corporation is a leading advisor and investor, represents to date an investment of $1,500,000, Mr. Szold said. Expansion plans calling for the addition of a mixed fertilizer plant will require about $3,000,000 more for buildings and equipment. This plant will be able to supply all of Israel's fertilizer needs.

To cover part of the additional facilities an application has been made for an allocation from the $100,000,000 loan recently granted Israel by the U. S. Export-Import Bank.

After more than 18 months' preparation and construction, Fertilizers and Chemicals, Ltd., has begun operations with a daily output of 55 tons of superphosphate and 25 tons of sulphuric acid. The buildings and

(*Continued*)

outdoor installations are located on a 90-acre site about 11 miles from Haifa. Negotiations were recently started in this country for the purchase of $220,000 worth of new equipment.

Raw materials are now being imported, but eventually some will come from the Dead Sea when Palestine Potash, Ltd., resumes its work there. This company in which the Palestine Economic Corp. is also an investor, has a concession for extracting the vast chemical deposits in the Dead Sea. Operations, halted by the Arab war, are expected to be resumed soon on an enlarged scale. A blueprint for this work is being prepared by the Chemical Construction Co., of New York.

Salt Production in India Below Needs

Bombay—Proposals for the modernization of India's salt manufacturing industry are being prepared by an official committee which has just surveyed production and demand and found domestic use to be careless and wasteful.

The survey showed that India produced 2.6 million short tons of salt last year compared with 2 million tons in 1947, but that imports to meet the gap between supply and demand continue at about 400,000 tons a year. Taking India's population at 330 million, this puts the annual per capita consumption at more than 18 lb., far more than required by standard dietary requirements.

In view of the shortage, salt imports from soft currency areas are freely permitted subject to a landed cost ceiling of 78 c. per 100 lb.

Record Output of Lime In Canada Last Year

Ottawa—Canadian production of lime in 1948 reached an all-time high of 1,053,600 tons, showing an increase of 7.8 percent over the previous high of 977,400 tons in 1947, the Canadian Government discloses, adding that the value of the 1948 output was $10,655,100 compared with $8,542,500 in the preceding year, an advance of 24.7 percent.

Of the quicklime produced in 1948, the report shows 785,100 tons were used for chemical and industrial purposes, and 65,000 tons for building and other uses. Hydrated lime used in chemical and industrial plants amounts to 96,800 tons and the building and agricultural trades purchased 106,800 tons. It is estmated that 1,792,700 tons of limestone were burned for the production of lime in 1948.

There were 42 establishments in operation in 1948 employing 1,121 persons who received $2,459,300 in salaries and wages. Cost of fuel and electricity amounted to $3,117,700 and cost of process supplies and containers $672,600.

Rubberized Leather Made By Melbourne Firm

Melbourne—Rubberized leather, a new shoe-making material, has gone into commercial production in Australia under an English license. It is made by the Melbourne rubber firm, Kenworth Australia Ltd. The material is known as Revitan and comes in two versions—R99 and R220. The manufacture involves teasing scrap leather into fibers and rebonding them with rubber latex. R99 is used for shoe insoles and midsoles while R220 is made for heavy duty uses.

Aussies Plan Tariff Wall On Plastics

Melbourne—Alarmed over increasing British and other foreign competition for the Australian market, domestic producers of formaldehyde and of plastics have made application to the Commonwealth Tariff Board for a revision of import duties. Hearings started in Melbourne late in July.

Some of the applicants are subsidiaries of English and American chemical concerns. Though Australian production is not sufficient to meet mounting demand for plastics, it is alleged that competition from low-cost foreign plants threaten to stifle the industry.

Under the present tariff classification it would be impossible to increase duties without raising the landed cost of some materials which are not produced in Australia and are therefore not object of the application. The tariff board may, however, recommend a reclassification with various rates of duty on different items.

Of all plastics now covered by a single tariff item, only the phenol, cresol, xylenol and resorcinol condensation products with aldehydes are produced domestically in appreciable quantities. Production of melamine plastics has just started. A third new tariff item may possibly cover vinyl chloride, vinylidene chloride, vinyl esters and vinyl ethers in any of

(Continued)

their polymerized and copolymerized forms, none of which are in commercial production in Australia.

Another subdivision may be recommended to apply different tariff rates to intermediate materials and powders, and to sheets, blocks, rods and other preformed shapes. Another question to be considered by the Tariff Board will be whether synthetic resins and preparations containing synthetic resins of a type mainly used in the production of paints, enamels and varnishes should continue to be admitted under the present low tariff.

Courtaulds Plans Rayon Plant Near Newcastle

Canberra—The English rayon firm of Courtaulds Limited has decided to establish a plant at Tomago, near Newcastle, New South Wales. It will invest $20 million initially, but may double the amount later. The Australian government has been assured that this does not involve any dollar expenditure because all equipment and know-how will be supplied by Britain. However, realization of the project will depend on the ability of English engineering firms to deliver the equipment. Therefore, no definite date for commencement of construction can be set.

Courtaulds will concentrate on rayon tire cord. Plans also include the manufacture of rayon yarn for 35,000,000 yd. of fabric. Australia's total requirements are 50,000,000 yd. a year, but Courtaulds is awaiting the outcome of competitive projects, including one in conjunction with Oscar Kohorn & Co. Ltd., New York, before it nails itself down to a larger volume of filament production.

Courtaulds has been in the news with substantially similar plans since 1939, but has never made a definite decision as to location and capacity. In the last three years some announcement has appeared at least once a month in the Australian press. Anxious to get some steam behind rayon filament production, the Department of Postwar Reconstruction recently invited Ralph von Kohorn, one of Oscar Kohorn's vice president, to examine the position firsthand. The result was the establishment of a company with a small nominal capital, but with powerful textile interests behind it, for the purpose of establishing an Australian-owned rayon plant with Kohorn's engineering assistance. However, a decision on this project is also hanging fire.

(Continued)

Swiss Chemical Exports Adversely Affected By Outside Bilateral Trade Agreements

Basel–Growing world trade restrictions are threatening to throttle the Swiss chemical industry. The postwar boom is fading and the industry is fighting to hold its place in a contracting world market. This is a life and death fight, for the industry must import nearly all its raw materials; export 90 percent of its total output to pay the bill.

The rate of new orders is off about 20 percent from last year's peak and backlogs have shriveled to a year or less in many lines. Foreign customers still would like to buy Swiss chemical specialties. But they have less and less hard currency with which to pay for imported chemicals; are tending to turn toward substitute, high-cost domestic sources of supply which are springing up rapidly in many parts of the world to answer this demand

Two world wars have sponged up the savings of many of the nations which were the Swiss chemical industry's best prewar customers. Western European nations were particularly hard hit. They have tried to protect their slim monetary reserves with currency controls, import quotas, import licenses, and bilateral trade and payments agreements.

These measures have been partially successful in protecting monetary reserves. But they have restricted the volume of trade between Western nations. They have encouraged national economic self-sufficiency by acting indirectly as shields for inefficient domestic industries. Worst of all, they have shut competition out of the world marketplace. Prices become irrelevant when commercial exchanges are negotiated between governments and tied sales are the rule. And by eliminating competition bilateral trading sharply reduces the chances of the economies involved getting on a sound paying basis by increasing productivity.

The Swiss chemical industry, as the country's third largest export industry after watchmaking and the machine industry, will be very hard hit if the Western World fails to free its trade channels of the rank growth of government controls which is blocking them today. Leaders of the industry are hoping against hope that Paul

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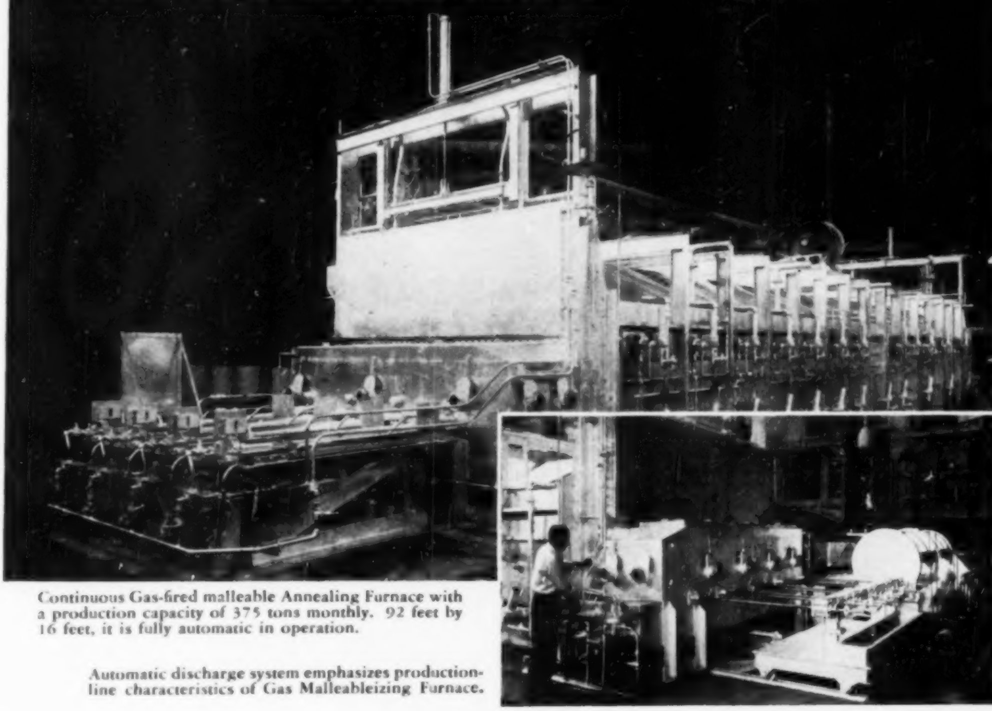
GAS MALLEABLEIZING



Continuous Gas-fired malleable Annealing Furnace with a production capacity of 375 tons monthly. 92 feet by 16 feet, it is fully automatic in operation.

Automatic discharge system emphasizes production-line characteristics of Gas Malleableizing Furnace.

Continuous Cycle Annealing

AT WALWORTH COMPANY

DEMONSTRATES PROCESSING SPEED OF *GAS*

MALLEABLEIZING of cupola iron is just one of the production-cycle operations in which GAS demonstrates its economic importance in modern industrial practice.

Factual results of this method of malleable annealing can be found in the records of Walworth Company's foundry at Greensburg, Pennsylvania. The reduction in processing time and the resulting higher strength and ductility are substantial.

But this is only the first savings factor in controlled atmosphere processing with modern Gas-fired furnaces. Other factors include:

- **reduction in amount of material tied-up in process**
- **absolute quality control of resulting product**
- **elimination of packing operation**
- **improvement in physical properties averaging 30% due to exact control**
- **control of malleableizing cycle to conform to production requirements**

Important advantages, these—each a cost-control factor in the manufacture of Walworth valves, pipe-fittings, malleable castings.

Throughout industry you'll find examples of the economic advantages of GAS and modern Gas Equipment as important as those at Walworth Company. Efficient utilization of GAS in modern heat-processing is worthy of the continuous study your Gas Company Representative will help you make. Call him soon.

MORE AND MORE... THE TREND IS TO GAS

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVE,. NEW YORK 17, N. Y.

FOREIGN NEWS, *cont.* . . .

Hoffman's Economic Cooperation Administration will succeed in goading at least the Marshall Nations into liberalizing their trade policies before the end of the Marshall Plan.

So far there aren't many encouraging signs that this hope will materialize. And until now the ERP has hurt the Swiss chemical business more than it's helped it. It's done this in two ways: It has steered intra-European trade around Switzerland who is not a participant in the clearing system set up under the Marshall Plan; and it has financed competing chemical industries in various Marshall Nations which have been able to take advantage of present trade restrictions to move into former Swiss markets.

Swiss trade in chemicals with the United States is relatively free from the hindrances it encounters in Europe. Some U.S. tariffs and import formalities hurt certain lines of Swiss chemicals, but by and large leaders of the industry feel confident that their products can eventually hurdle any reasonable tariff. Swiss importers of chemicals on the other hand, complain bitterly about the letters of credit which many American exporters have demanded since the war. They say this method of paying not only is time consuming but it ties up large sums of capital unproductively for long periods of time.

Industry leaders are confident, however, despite these difficulties, of the ability of their industry to survive and prosper provided world trade can be freed even as much as it was before the war. They point out that the industry has the following natural advantages over its rivals: It has all the capital it needs to finance research and judicious expansion. All of Switzerland's big chemical concerns have been self-financing for years; are solid as banks financially. This is particularly important for the Swiss industry which must compensate for its small output by developing highly specialized quality products. That means whopping research costs.

The industry is extremely flexible since it doesn't operate on a mass production basis in the U.S. sense of the term. It can shift its production schedules fast with shifting world demand and develop products more nearly suited to the needs of individual clients. It has probably the most complex, and highly developed international sales and publicity organizations of any chemical industry in the world since Germany was sent back to first base. It can draw on a pool of extremely highly skilled workers and technicians. The high educa-

(Continued)

FOREIGN NEWS, cont. . .

tional qualifications of Swiss workers and technicians and their industry, patience and ingenuity are world renown.

It has a hard currency with which to pay for its essential imports of raw materials. It generally has had bold, and imaginative leaders seasoned by the dangers and dilemmas of foreign trading. Directors of the industry travel a lot following world market developments personally. They think nothing of flying to Rio, or New York, or Bangkok on an hour's notice.

Those are the weapons with which the Swiss chemical industry will fight its world trade battles. They are trusty, time-tried weapons. But leaders of the industry know that no matter how effective they may be the final outcome of the struggle to free Western trade from crippling restrictions will be decided in Washington, London, and Paris, not Basel or Berne. That's why they are looking to the leaders of the American chemical industry for support in the battle for a free world marketplace without which they doubt that free enterprise can survive even in the U. S. They're sure it couldn't survive long in Switzerland.

EXPORTS HOLD UP

So much for the future of the Swiss chemical industry. The present and immediate past present a brighter picture. Exports still haven't felt the impact of declining orders and last year's figures hit new highs. There was a decrease, however, in exports of the electrochemical and electrometallurgical industry which was particularly marked for hydrogen peroxide, chlorates and peroxide salts.

The aluminum and light metal industry, on the other hand, held production at 1947 levels. Domestic sales were good and exports increased, although remaining less than prewar. The magnesium industry, however, still is limping badly. The ferro-alloys and abrasives industry increased production and sales reflecting the unabated prosperity of the iron and machine industry.

Production of phosphoric acid and superphosphates edged up. But Swiss superphosphates are bucking stiff competition on the domestic market from heavy imports of Thomas slag and foreign superphosphates. A series of derivatives of pure and chemically pure phosphoric have recently been put on the market, notably salts for dietetic supplements, medicaments, and soluble fertilizers. Principal exports so far have been filter materials and other supplies for water purification plants.

The carbide industry moved into the export market for the first time since the war last year. Domestic sales for welding also increased. But both domestic and foreign sales of carbide and acetylene derivatives sagged.

Output of nitrogen from ammonia and carbide was held at 1947 high levels by increased exports which compensated for new drops in domestic demand last year.

The plastics industry has run into stiffening buyer-resistance which has sapped the demand for methanol, formaldehyde, and urea.

The pharmaceutical industry had an uneven year last year. Exporters faced growing complications in the world market which kept the industry constantly shifting its plans. The raw materials market generally was steadier and more predictable than the year before. Raw materials were in adequate supply quantitatively, and fears that the Marshall Plan might create new shortages didnt materialize. The U. S. easily held its place as number one supplier of the Swiss pharmaceutical industry. Over-all demand for Swiss pharmaceuticals continued strong last year. But growing payments difficulties in international trade stifled an important part of this demand.

Increased exports of coal-tar dyes both in quantity and value made 1948 a good year over-all for the dye industry. Raw materials bottlenecks also were eased or eliminated. But Swiss dyes bumped into major and sometimes unsurmountable obstacles in a number of traditional export markets notably in Europe. Fears are expressed in the industry that if these markets can't be reopened soon sales organizations there may deteriorate badly.

HOME SALES DIP

Domestic sales took a sharp dip particularly in the export sector of the textile industry. Sales of laundry detergents still haven't reached prewar levels. Prices of oils and fats climbed steeply in the first few months of last year to levels five plus times higher than in 1939. Perfume sales lagged badly compared to 1947.

The chemical industry as a whole still is working at near capacity levels although employment began to fall over slightly this spring. The industry accounted for a slightly larger percentage of total Swiss exports last year —17.85 percent versus 17.70 percent the year before. It held its place as the third largest export industry in the country after watches and machines.

The United States not only was Switzerland's biggest supplier of chemicals last year, it was its second most

(Continued)

important customer. The volume of Swiss-American trade also increased considerably. Here are the figures:

Chemicals in Dollar Equivalents

	U. S. Exports to Switzerland	U. S. Imports From Switzerland
1948	$39,882,186	$8,278,632
1947	$37,440,013	$5,394,435

The rapid comeback of Germany as a supplier and buyer of chemicals was another outstanding development of the Swiss chemical industry's foreign trading in 1948. Both imports and exports tripled over 1947 levels. The figures are:

Swiss-German Trade in Chemicals 1948

	Swiss Imports From Germany	Swiss Exports to Germany
Pharmaceuticals and perfumes	$729,256	$1,102,880
Industrial chemicals	$6,197,960	$1,218,928
Dyes, pigments	$2,422,399	$1,069,750
Fats, oils, waxes	$103,046	$120,329
Total	$9,462,661	$3,541,887

Swiss-German Trade in Chemicals 1947

	Swiss Imports From Germany	Swiss Exports to Germany
Pharmaceuticals and perfumes	$329,990	$500,948
Industrial chemicals	$1,960,208	$170,892
Dyes, pigments	$849,948	$394,167
Fats, oils, waxes	$26,382	$33,229
Total	$3,166,529	$1,099,236

The following statistics for over-all Swiss trade in chemicals show a less marked improvement. Here they are:

Swiss Foreign Trade in Chemicals 1948

	Exports	Imports
Pharmaceuticals and perfumes	$52,579,352	$13,237,024
Industrial chemicals	$30,441,743	$59,759,131
Dyes, pigments	$67,334,068	$9,075,190
Fats, oils, waxes	$2,616,911	$25,034,221
Total	$152,972,074	$107,105,566

Swiss Foreign Trade in Chemicals 1947

	Exports	Imports
Pharmaceuticals and perfumes	$57,479,634	$14,130,089
Industrial chemicals	$24,107,372	$59,944,930
Dyes, pigments	$59,292,438	$7,431,343
Fats, oils, waxes	$3,738,387	$22,660,887
Total	$144,717,831	$104,167,249

The rapid recovery of German trade in chemicals may well herald a retreat of the U.S. industry from its present position of preeminence in Swiss trade. Before the war Switzerland exported 15.7 percent of its chemicals to Germany and relied on Germany for 23.2 percent of its chemical imports. Corresponding percentages for the U. S. were 6.9 percent and 7.8 percent prewar versus 5.25 percent and 37 percent today.

Germany has three advantages over the U.S. in trading with Switzerland. First, its geographical proximity. Second, German chemical firms normally

maintain representatives in Switzerland whereas U.S. practice is to try to sell the Swiss market from the United States. Three, German manufacturers, according to the Swiss, make more of an effort to adapt their chemical products to the individual needs of their customers and to comply with the pharmaceutical regulations in force in various countries whereas as a rule U.S. products only conform to USP or the NF.

Larger Supplies and Greater Competition Weaken Solvent Prices in Great Britain

London—The hoped-for swift recovery of the British chemical market after the holiday period has been prevented or at least delayed by uncertainty about the currency and general economic situation. Assured of prompt delivery of most chemicals, consumers generally prefer to await further developments before committing themselves far ahead. In these circumstances home business is more or less of a routine nature. Sales are mainly confined to lots for early delivery, and inquiries from other than regular users are disappointing.

There is much talk of the need for higher productivity and greater effort by managements and workers, but as far as the chemical trades are concerned, the need for drastic measures is apparently not believed to be urgent. Few price changes occurred during last month. Metal compounds rose in line with the advance of the Ministry of Supply prices for virgin metals, and borax, white arsenic and a number of solvents have been reduced in price. Generally chemical prices remain unchanged.

The price cut for solvents is of some interest insofar as it coincides with the appearance in the market of larger supplies of solvents from the Shell petroleum chemicals plant at Stanlow which is now in full operation. Shell Chemicals Ltd. has lowered its prices for methyl ethyl and isobutyl ketones, for secondary butyl alcohol and for isopropyl ether from September 1. Other petroleum chemicals makers are known to expand their output. Irano Products Ltd., distributors for the Anglo-Iranian Oil Co. Ltd., is marketing two new sodium alkyl sulphate products. Petro-

(*Continued*)

FOREIGN NEWS, *cont.* . . .

chemicals Ltd. has announced that its 1949-50 production will include thiophene-free benzene and toluene, xylene, close-cut aromatic solvents, methyl naphthalenes, ethylene, ethylene and propylene oxide and glycol, isopropyl alcohol and aromatic bitumens. Growing supplies of these and other petroleum-derived chemicals cannot remain without effect on the price level of the products.

The big works of Imperial Chemical Industries Ltd. at Wilton began operations on September 14. A statement to this effect was made in August when it was also disclosed that the plant would soon provide employment for 3,000 people and was expected to give work to 8,000 by 1951 and 11,000 by 1955. Designed for the use of both coal and petroleum as raw materials, the Wilton works were, according to an earlier announcement, to begin the production of phenol formaldehyde molding powder and "Perspex" acrylic sheet by the summer of 1949. Later many more organic chemicals will be produced at Wilton, including a good many which will also be provided by specialized petroleum chemicals plants now in course of erection or extension.

Prospective producers are of course trying to test the market before actually starting production, but little seems to be known as yet of the total supply of various products from all the new plants and even less of the likely outlets open at various price levels. Considerable competition, however, is anticipated and has already been noticed in some of the new products introduced into the British market by local producers, especially synthetic detergents.

Growing attention is being paid by chemical manufacturers to the export market in view of the apparent saturation of the home market and the difficulties being experienced of late in many foreign countries owing to import restrictions, currency shortages and intensified competition. While Lord McGowan, chairman of Imperial Chemical Industries Ltd., told workers of his company that "the slight recession in business apparent today" would not go far and buy resistance was already slackening. Lord Trent, chairman of Boots Pure Drug Co. Ltd., told his shareholders that "the hectic rise of Britain's export trade in the past three years has been unreal and unhealthy." The export drive would have to be conducted on more expert lines now that the transient phase of world demand for any goods at any price had come to an end.

Lord McGowan, on the other

hand, believes that the trade position will be stabilized "in the not too distant future." South America would become an even greater market for British manufactures, and even in the United States there were still outlets for ICI commodities. At home the textile industry was clearing its stocks and could be expected to begin buying ICI dyestuffs again in the near future.

Additional finance of $25,000,000 is being sought by Fisons Ldt., the company accounting for about half the trade in chemical fertilizers in Britain, in connection with the plant extension program initiated in response to the government's call for increased production of phosphatic fertilizers. Over $20,000,000 are needed for the ensuing development program. It includes a new triple superphosphate factory at Immingham which it is hoped to put into operation within the next twelve months, and another $7,000,000 are required for financing stocks at increased value and additional turnover. Fison's fertilizer sales in the year ended June 1949 were about 100,000 long tons up on the previous year and substantial further output gains are expected as more of the extensions and new plant under construction are reaching the productive stage. Although British agriculture is entering a new and more critical phase with the return of more normal conditions in overseas food producing areas and the Ministry of Agriculture has announced its intention of gradually withdrawing the fertilizer subsidy in the next two years, Fison's like other British fertilizer manufacturers anticipate that all factories will be able to work to maximum production for some years to come.

The paint industry has suffered an appreciable contraction of export business in many important products, including earth colors, lithopone, metallic pigments generally, lead and zinc oxide in paste form and ships' bottom compositions, but this has on the whole been offset by increased shipments of unspecified dry pigments and bituminous paints, largely to soft-currency markets. The home market, though adversely affected by a downward revision of postwar house-building targets, has been kept up well so far by larger demands for delayed maintenance painting. Nevertheless, considerable difficulties are being anticipated for the near future, and leading producers endeavor to improve their competitive position by increased mechanization. Thus Pinchin, Johnson & Associates, Ltd, the biggest firm of paint makers in Brit-

(Continued)

ain, intends to erect a new building in the London area, "with the most modern layout, designed for large volumes of highest-quality products, and with maximum flexibility of operation." A separate, small-batch factory has been completed by the company in London for works-scale experimentation and to deal with relatively small order batches to suit individualistic needs so as to relieve the bigger producing units of uneconomic loads. Further installations including bulk resin and medium making plant are to be provided, and an extensive program of rehabilitation and expansion is being carried out.

Substantial investments are also being made by smaller paint manufacturers with special regard to opportunities opened by the British petroleum chemicals industry, the cultivation of vegetable substitutes of linseed oil in Britain's African colonies and changes in surface coating techniques resulting from these and other factors.

Radioactive isotopes made at the Atomic Energy Research Establishment at Harwell have been sent to German universities for use in biological and medical research for a few months now.

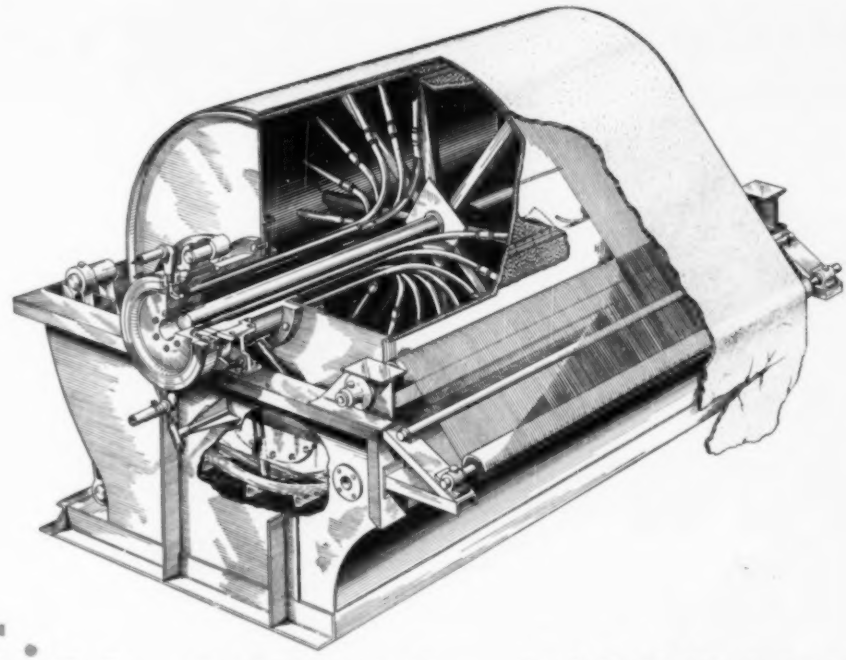
Chemicals, dyestuffs and paints worth \$8,000,000 are to be sent to Brazil by British manufacturers under the 1949 Anglo-Brazilian Trade Agreement which has now been confirmed.

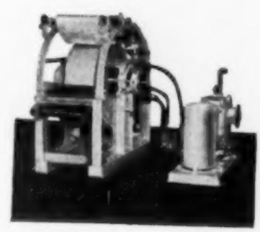
British chemical exports in July suffered a further decline to \$25,700,000, compared with \$27,800,000 in June and \$32,360,000 in May, largely owing to a decline in shipments to India where importers are believed to be holding substantial stocks of many chemical products.

Indian Glass Industry Wants Cut in Imports

Bombay — Seeking protection against lower-priced foreign products, the Indian glass industry has stated to the Indian Tariff Board that its rated capacity is between 15 and 20 million square feet of sheet a year compared with national requirements for at least 32 million annually for the next three years.

Industry spokesmen told the board that so much foreign glass has been imported during the past year that the three largest sheet producers have temporarily suspended production. Because of this they are asking quantitative restrictions on imports as well as price protection. —*End*





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The Corrosion Forum

EDMOND C. FETTER, Assistant Editor

Hydrofluoric Acid versus Construction Materials

Part III of a three-part symposium in which a representative group of construction materials are evaluated for services involving HF.

Lead

KEMPTON H. ROLL, *Lead Industries Association, New York, N. Y.*

Hydrofluoric acid is one of the principal mineral acids to which lead is corrosion resistant. Lead of $\frac{3}{16}$ in. or greater thickness usually gives years of service in equipment handling this chemical, particularly if the acid is at room temperature.

The limiting concentration lies in the range of 60 to 65 percent, depending on the acid temperature. Lead has been used successfully with unaerated 60 percent acid up to the boiling point (184 deg. F.). Nevertheless the use of lead with hydrofluoric acid at temperatures above room temperature is generally to be recommended with caution.

Considerable lead is used for storage, conveying and pumping hydrofluoric acid solution. At one time it was also used extensively for shipping the acid.

Some actual plant corrosion tests were conducted in dilution and storage vessels for 60 to 40 percent hydrofluoric acid. At average atmospheric temperatures, the test specimens were immersed in the acid solution for a period of 33 days. The lead corroded at the rate of 3 mils per year. In another test, commercial 60 to 65 percent hydrofluoric acid containing 15 to 25 percent fluosilicic acid, 0.3-1.25 percent sulphuric acid and 0.01-0.03 percent iron was held in storage. The test specimen was immersed in the solution which ranged from 60 to 80 deg. F. in temperature. After 28 days exposure, the corrosion rate for lead was shown to be 16 mils per year.

A reprint of all three parts of this symposium on hydrofluoric acid is available at 35c. per copy. Address Editorial Dept., *Chemical Engineering*, 330 W. 42nd St., New York 18, N. Y.

Many ore roasting plants convert their roaster gases to sulphuric acid, in this manner protecting the community against hazardous air contaminants as well as recovering a valuable product. Due to the presence of fluoride minerals in most zinc ores, the roaster gases often contain fluorine which must be removed prior to sulphur dioxide conversion. This is almost invariably accomplished by forming hydrofluoric acid and collecting it in lead-lined vessels. In one installation fluorine is encountered in a corrosive coolant liquor to the extent of 1 g./liter. No effect on the lead linings in the coolant handling equipment has been apparent for the past several years of operation.

In the manufacture of anhydrous hydrofluoric acid (AHF), lead is satisfactorily used as a construction material for circulating pumps.

It is important in discussing corrosion that a uniform system of designation be used, such as mils or inches penetration per month or year, or milligrams per square decimeter per day. But either of these systems can be somewhat misleading insofar as the common tendency is to judge best performance on the basis of the lowest corrosion rate. This is especially true in the case of lead in chemical equipment which for mechanical reasons is used in thicknesses generally of $\frac{3}{16}$ in. or greater. Such thicknesses are of a distinct advantage from a corrosion viewpoint. Other corrosion resistant materials are normally used in much lighter thicknesses. Thus for equal uniform corrosion rates, lead would far outlast such other materials because of this difference in thickness.

Designating corrosion rate according to weight loss as milligrams per square decimeter per day instead of volume loss as inches penetration per year is also misleading in the case of lead since lead has the highest density of any commonly used corrosion resistant material. This means that what might appear to be an excessive corrosion rate expressed in weight loss of lead could actually be a very nominal rate of corrosion in terms of volume loss.

When comparisons are being made between various corrosion resistant materials it follows that an understanding and appreciation of the above will lend much to the proper interpretation of corrosion rate data.

Silicones

J. A. MCHARD and A. F. KOLB, *Dow Corning Corp., Midland, Mich.*

Dry hydrofluoric acid rapidly attacks silicone fluids and polymers to form volatile products. The aqueous acid reacts more slowly and the extent of reaction depends upon the type of silicone.

Tests carried out by heating samples of various silicone products at 80 deg. C. for nine days in contact with aqueous, 48 percent hydrofluoric acid are summarized in the following table.

The progress of the deterioration appears to be toward low polymers and consequently more volatile products as shown by weight loss and viscosity data. Literature sources [1,2,3] also bear out the conclusions reached here. Hydrofluoric acid apparently attacks the

(Continued)

Effect of Heating Silicones in 48 Percent HF (Nine Days at 80 Deg. C.)

	Weight of Specimen		Viscosity in Cstks.		
Type of Silicone	Before Heating	After Heating	Before Heating	After Heating	Remarks
Fluid					
DC 200	3.5138	0.5310	206	16	Fluid remained clear with no discoloration.
DC 710	3.7676	0.6524	476	294	Fluid remained clear with no discoloration.
Grease					
DC Valve Seal A	3.8471	0.6325	...	15	Sample lost its consistency and became fluid.
Elastomers					
Silastic* 125	5.7542	......	...	...	Specimen powdered and disintegrated.
Silastic 150	7.8703	......	...	...	Specimen powdered and disintegrated.
Silastic 181	4.7328	0.3029	...	...	Specimen badly deteriorated.
Silastic 250	5.5921	......	...	...	Specimen badly deteriorated.

* Trade-mark Registered, Dow Corning Corp.

Table I—Laboratory Corrosion Tests, Monel in Hydrofluoric Acid

Acid Conc., % HF By Wt.	Temp., Deg. F.	Duration of Test, Days	Other Test Conditions	Corrosion Rate, Mils per Year: Wrought Monel	Cast Monel	"H" Monel	"S" Monel
10	70		Immersed in open container	9			
10	136	0.8	Immersed in open container	8			
25	86	6	Air-free, immersed in closed container, velocity 42-73 ft./min.	0.2	0.6	0.4	0.2
25	86	1	Air-saturated, immersed in closed container, velocity 42-73 ft./min.	37	19	19	9
25	176	6	Air-free, immersed in closed container, velocity 42-73 ft./min.	2.4	1.3	0.4	0.2
25	176	1	Air-saturated, immersed in closed container, velocity 42-73 ft./min.	11	20	22	21
35	248	6	Air-free, immersed in closed container	1.1			
48	68		Immersed in open container	4			
48	240	8	Immersed in closed container	0.9			
50	86	6	Air-free, immersed in closed container, velocity 42-73 ft./min.	0.1	0.5	0.2	0.4
50	86	1	Air saturated, immersed in closed container, velocity 42-73 ft./min.	8	6	7	3
50	176	6	Air-free, immersed in closed container, velocity 42-73 ft./min.	0.6	2.2	0.9	2.0
50	176	1	Air-saturated, immersed in closed container, velocity 42-73 ft./min.	39	37	44	46
60	Room	2	Immersed in open container	15			
70	70	8	Immersed in closed container	0.1			
70	122	4	Immersed in closed container	4.2			
70	240	8	Immersed in closed container	17			
93	70	8	Immersed in closed container	3			
98	240	8	Immersed in closed container	2			
100	100		Immersed in closed container, velocity 1,700 rpm.	0.9			
100	300	8	Immersed in closed container	0.9			

CORROSION FORUM, *cont* . . .

silicone molecule at the Si-O-Si linkage rather than at the C-Si bonds. No hydrocarbons have been detected in the byproducts of these reactions.[2,3]

From the data here and in the literature, one would conclude that silicones of the type $(R_2SiO)_x$ react with HF to form eventually R_2SiF_2.[4]

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Nickel, Nickel Alloys

W. Z. FRIEND, *International Nickel Co., New York, N. Y.*

HYDROFLUORIC ACID — Experience with Monel in a variety of applications involving hydrofluoric acid has shown it to be usefully resistant to all concentrations of the acid including anhydrous acid over a considerable range of temperatures. It is, in general, the most resistant material with the exception of platinum and silver. In hydrofluoric acid-water solutions, except in those which are highly aerated, Monel has shown satisfactory resistance up to 250 deg. F., the highest temperature for which test data are available.[1] The results of laboratory corrosion tests in hydrofluoric acid solutions are shown in Table I. The results of plant corrosion tests in hydrofluoric acid pickling solutions are shown in Table II.

The indications are that the corrosion resistance of Monel is not adversely affected by the presence of small amounts of reducing sulphur compounds or of sulphuric acid in hydrofluoric acid solutions. However, its corrosion rate may be appreciably increased by a high degree of aeration of the solution. Table I shows the effect of air saturation of 25 and 50 percent acid solutions on the corrosion rate of Monel at 86 and 176 deg. F.

Tests with highly stressed specimens in commercially pure acid solutions, and general plant experience, have shown that Monel is not subject to stress-corrosion cracking in hydrofluoric acid which does not contain appreciable amounts of fluosilicic acid.

Monel is comparatively insensitive to effects of velocities which considerably increase the corrosion rates of such materials as copper and bronzes in strong hydrofluoric acid. This is shown by the satisfactory performance of Monel bubble caps in HF distillation columns. Other examples of suitable applications of Monel for such equipment as acid recovery towers and heaters, valves, bolts, pumps, and pipe lines in the most corrosive conditions encountered in alkylation-plant operation, have been cited.[2,3] The results of plant corrosion tests in hydrofluoric acid alkylation plants are shown in Table III on the next page.

(Continued)

Table II—Plant Corrosion Tests in HF Pickling Solutions

	Corrosion Rates, Mils per Year: 6% HF, Temperature.: 170 Deg. F., 4 Day Test	28 Day Test	10% HF, Temp.: Room, 30 Day Test
Monel	0.8	0.2	0.1
Nickel	350	.....	0.1
Inconel	363	66	0.1
Ni-Resist	880	540	1
Cast Iron	*	*	220

Test specimens immersed in solutions in pickling tanks used for pickling cast iron. * Specimens completely corroded away; original thickness 3/16 in.

Table III—Corrosion Tests in HF Alkylation Plants

Test 1—Inlet side of preheater channel, Plant A. Liquid composition: 79-92 percent HF, 0.8-2.5 percent water, remainder isobutane and acid-soluble oil. Temperature: av. 120 deg. F., max. 135 deg. F. Duration of test, 111 days.

Test 2—Outlet side of preheater channel, Plant A. Composition same as Test 1. Temperature: av. 235 deg. F., max. 260 deg. F. Duration of test, 111 days.

Test 3—Top of regeneration column just below vapor outlet, Plant A. Composition: 90-95 percent HF and 5-10 percent isobutane. Acid phase: 90-95 percent HF, 0.5-2.5 percent water, 1.0-5.0 percent oil. Temperature: av. 275 deg. F., max. 300 deg. F. Pressure 120-150 psi. Duration of test, 70 days.

Test 4—Top of regeneration column, Plant B. Composition: equal parts of 93 percent HF and isobutane vapor. Temperature: av. 215 deg. F., max. 220 deg. F. Duration of test 49 days.

Test 5—Bottom of regeneration column (Plant B) in acid tar containing, in 1:1 ratio, water and 1-10 percent HF. Temperature: av. 250 deg. F. Duration of test, 49 days.

Test 6—Bottom of regeneration column, Plant C. Feed to column contains 85.2 percent HF, 1.6 percent water and oils. Test made beneath grid plate of column. Feed, 194 bbl. per day. Temperature: av. 220 deg. F., max. 250 deg. F. Duration of test, 45 days.

Test 7—Bottom of dehydrator column beneath bottom plate, Plant C. Feed contains 89.3 percent HF and 1.6 percent water. Feed rate, 15 bbl. per day. Temperature: av. 225 deg. F., max 250 deg. F. Duration of test 45 days.

Test 8—Top of HF stripper column above top tray, Plant A. Composition of vapor: 10 percent HF and 90 percent light hydrocarbons. Temperature: av. 110 deg. F., max. 150 deg. F. Duration of test 117 days.

	Corrosion Rate, Mils per Year				
	Monel	"S" Monel	Nickel	Inconel	70-30 Copper-Nickel
Test 1	0.3	....	1.1	0.8	1.1
Test 2	0.5	....	3.5	19	6
Test 3	0.5	....	13	0.7	0.7
Test 4	0.5	1.4	14	25	5.3
Test 5	7.5	10	11	23	21
Test 6	7.1	11	18	25	
Test 7	22	39	68	*	
Test 8	0.7	....	0.7	0.5	1.3

* Completely corroded away; original thickness 0.032 in. (32 mils).

Corrosion Forum, *cont* . . .

The corrosion rates for Monel can be applied equally well to "K" Monel, a wrought age-hardening nickel-copper alloy, and to the cast alloys, "H" Monel (containing approximately 3 percent silicon) and "S" Monel (containing approximately 4 percent silicon). "K" Monel is used for such parts as pump shafts, valve stems, and bolts, which are subject to high stresses.

"S" Monel, having high hardness and galling resistance, is used for such parts as gate and plug valves, pump parts, and sometimes for non-lubricated bearings, where seizing must be avoided or where "freezing" of steel parts might occur.

Limited experience with nickel indicates that in dilute hydrofluoric acid solutions its corrosion resistance may be limited to temperatures below about 170 to 180 deg. F. In a commercial 60-65 percent acid, it was corroded severely at atmospheric temperature.

INCONEL AND NI-RESIST

Inconel is resistant to aqueous hydrofluoric acid solutions at atmospheric temperature and sometimes to temperatures as high as 160 to 170 deg. F. The presence of small amounts of ferric salts in commercial solutions is favorable to the performance of Inconel.

The alloy cast iron, Ni-Resist, containing 13.5-17.5 percent nickel, 5.5-7.5 percent copper and 1.75-2.5 percent chromium, is resistant to dilute aqueous hydrofluoric acid solutions at atmospheric temperature but not at elevated temperatures. It was appreciably corroded by commercial 60-65 percent acid at room temperature. Ni-Resist was reported to suffer graphitization in anhydrous acid.[3]

HYDROGEN FLUORIDE—Laboratory corrosion test results reported by Myers and De Long[4] and given in Table IV have shown Monel, nickel and Inconel to be among the materials most resistant to anhydrous hydrogen fluoride at temperatures up to 1,100 deg. F. Tests in mixtures of hydrogen fluoride and steam reported in Table V showed suitable resistance for nickel and Monel. If sulphur compounds are present, nickel and Monel may be subject to intergranular sulphur attack at temperatures above about 570 deg.

(Continued)

Table IV—Corrosion of Various Metals by Anhydrous HF at Elevated Temperatures

	Corrosion Rate, Mils per Month		
	At 500 Deg. C	At 550 Deg. C	At 600 Deg. C
Nickel	3		3
Monel	4	4	6
Copper	5	....	4
Inconel	5	....	5
Aluminum (2S)	16	....	48
Magnesium (Dow Metal G)	12		
1020 Steel	51	48	25
Type 304			44
Type 347	600	1,500	590
Type 309-Cb	19	140	550
Type 310	40	330	1,000
Type 430	5	30	38

Table V—Corrosion of Nickel and Monel in Hydrogen Fluoride-Steam

	Corrosion Rate, Mils per Month	
	Monel	Nickel
At 550 deg. C		2.6
At 600 deg. C	2	6
At 650 deg. C	5	9
At 700 deg. C	13	12
At 750 deg. C	17	10

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F. In such applications at higher temperatures Inconel would be preferred.

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Durimet-20

WALTER A. LUCE, *Duriron Co., Dayton, Ohio*

Durimet-20 provides good resistance to many concentrations of hydrofluoric acid and is utilized in industry where this severe corrosion is encountered. It is especially valuable if the operating conditions are sufficiently oxidizing to render unsuitable many of the other hydrofluoric acid resisting alloys, which usually contain high copper.

Durimet-20 is a highly alloyed austenitic stainless steel with a nominal chemical composition in the cast form of 29 percent Ni, 20 Cr, 2.5 Mo, 3.5 Cu, 1.0 Si, 0.07 C max and balance Fe. It is available in the form of castings and equipment made from castings such as pumps, valves, fans, ejectors, jets and mixing nozzles. Rough castings are supplied various other manufacturers who produce diversified equipment in this composition.

Laboratory testing of Durimet-20 in several concentrations of dilute hydrofluoric acid showed the following results:

	Corrosion Rate, Mils per Year		
HF Conc.	5%	15%	25%
Durimet-20			
Room temp.	3	5	4
50 deg. C.	10	14	17
80 deg. C.	11	21	28

These data indicate that excellent service can be expected at the lower concentrations even above normal temperatures. Substantiating results were obtained from a group of plant tests which showed Durimet-20 to be the equivalent of other known hydrofluoric acid resisting alloys at concentrations up to 20 percent at moderate temperatures, even in non-aerated solutions. Another group of tests conducted under a slight degree of aeration indicated low corrosion rates on Durimet-20 at all concentrations of this acid at normal temperatures.

Plant experience has shown Durimet-20 to be an acceptable alloy for concentrations of the pure acid above 60 percent. For instance, one chemi-

(Continued)

cal plant used Durimet equipment for handling 60 percent HF at ambient temperatures and the 80 percent acid at approximately 35 deg. C. Durimet-20 has also been utilized to a limited extent on anhydrous hydrofluoric acid with excellent results. The fact that low carbon steel is a satisfactory material for AHF generally limits the use of higher alloy materials of construction. Durimet-20 "Y" valves after two years' service on cold HF of undisclosed concentration in one chemical plant showed no visible signs of corrosion.

Aerated hydrofluoric acid or solutions containing oxidizing materials in which HF exists in a substantial concentration are those in which Durimet-20 provides exceptionally good service. The common stainless steel pickling solution, which may contain from 3-5 percent hydrofluoric acid and up to 20 percent nitric acid and operating at temperatures up to 170 deg. F. is an excellent example of the latter type and is an exceptionally severe service for heating equipment; i.e., steam jets. Although by no means immune to attack, plant tests on Durimet-20 samples and actual equipment proved it to be the most economical material of construction available. Equipment such as valves, jets, and tank outlets are being employed on such installations. Durimet-20 pumps are also utilized on these installations and often handle other pickle solutions and waste acid in addition to the nitric-hydrofluoric mixture. Durimet-20 valves are also being used by many refineries in alkylation processes embodying the use of hydrofluoric acid.

Durimet-20 has also been under test on many severe services encountered in the production of hydrofluoric acid where fluorspar is treated with concentrated sulphuric acid. It is known that slightly oxidizing conditions tend to exist in this service. The use of this alloy for certain equipment is indicated by these plant and service tests. One of these tests consisted of installation of actual equipment.

Wrought Durimet-20 is produced by the Carpenter Steel Co. and is supplied under the name Carpenter Stainless No. 20. The present forms in which the wrought alloy is available include wire, rods, bars, sheet, plate, strip, and welded pipe and tubing. Duriron or Carpenter Steel should be consulted regarding the sizes of the various forms available. Durimet-20 welding electrodes and certain fastenings can also be obtained.

Plant tests conducted on Carpenter 20 and several other alloys recom-

(Continued)

mended for use in the etching of glassware where two solutions must be separately handled, namely, (1) 47 percent hydrofluoric acid and 6 percent hydrofluosilicic acid at normal room temperature and (2) 15 percent nitric acid at normal room temperature, showed the following results:

	Corrosion Rate, Mils per Year
Carpenter Stainless No. 20	8
Type 316 stainless steel........	30
Non-ferrous alloy No. 1.	40
Non-ferrous alloy No. 2.	106

Durimet-20 is also being applied in numerous other solutions where hydrofluoric acid is encountered in small percentages. Typical examples include halogen tin plating solutions and crude phosphoric acid production by the wet process.

Rubber-Lined

E. L. Lockman, *United States Rubber Co., New York, N. Y.*

Rubber linings can be supplied which will satisfactorily handle hydrofluoric acid under a variety of service conditions. The determination as to whether soft or hard natural rubber or one of the synthetics should be used depends upon the concentration of the acid, operating temperature and whether or not the condition is an abrasive one.

Soft butyl and neoprene linings are suitable for handling 60 per cent acid at temperatures up to 160 deg. F. Weaker concentrations of the acid may be handled at temperatures as high as 220 deg. F.

Hard natural rubber linings will satisfactorily handle 40 percent acid at room temperature or weaker concentrations may be handled at slightly higher temperatures. Soft natural rubber linings should not be used in contact with hydrofluoric acid containing more than 3 percent acid at room temperature.

As can be seen from the above, butyl and neoprene linings are usually specified for hydrofluoric acid service. All types of equipment such as storage equipment, pipe and fittings, reaction vessels and shipping containers have been lined with these two materials with very satisfactory results. Experience indicates that butyl linings are superior to neoprene linings at temperatures above 200 deg. F., but at lower temperatures neoprene linings have better physical properties, particularly for handling abrasive conditions such as caused by slurries.

Mixtures of hydrofluoric acid with other acids such as nitric can also be

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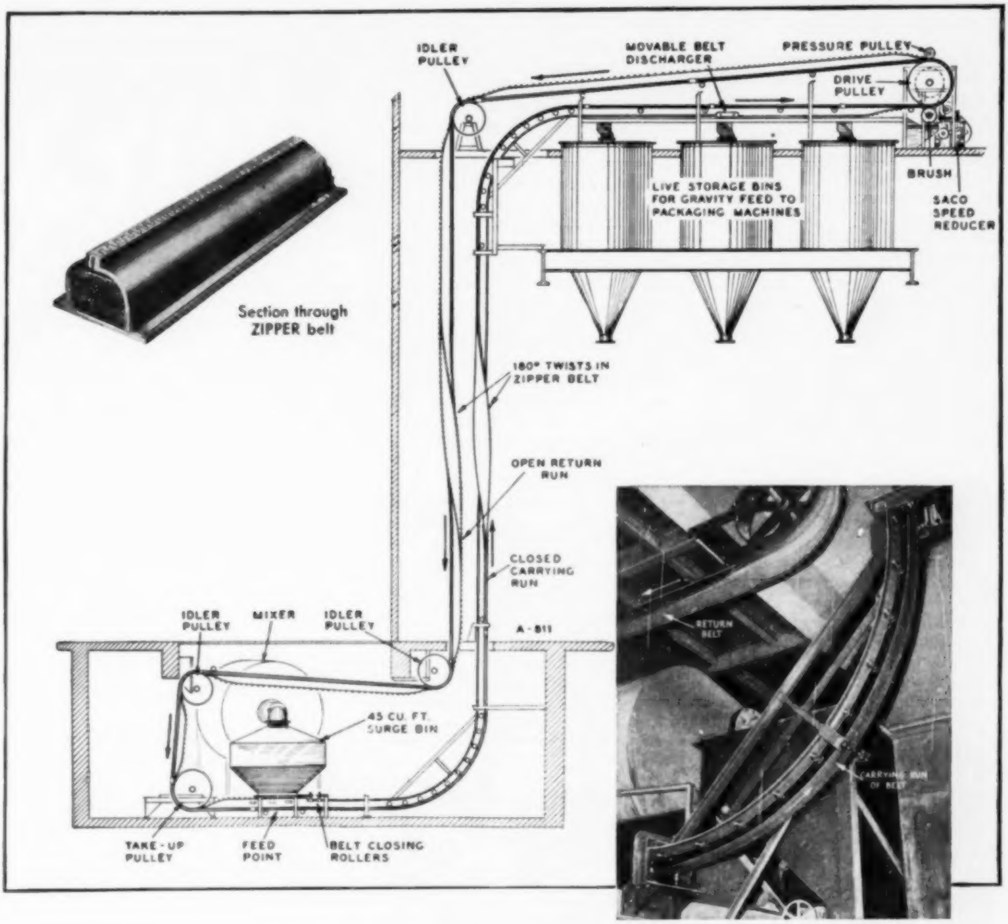

IDLER PULLEY
MOVABLE BELT DISCHARGER
PRESSURE PULLEY
DRIVE PULLEY
BRUSH
LIVE STORAGE BINS FOR GRAVITY FEED TO PACKAGING MACHINES
SACO SPEED REDUCER
Section through ZIPPER belt
180° TWISTS IN ZIPPER BELT
OPEN RETURN RUN
CLOSED CARRYING RUN
IDLER PULLEY
MIXER
IDLER PULLEY
A-811
45 CU. FT. SURGE BIN
TAKE-UP PULLEY
FEED POINT
BELT CLOSING ROLLERS
RETURN BELT
CARRYING RUN OF BELT

satisfactorily handled with neoprene or butyl linings provided the concentration of each acid does not exceed 35 percent at room temperature.

A removable type of liner made from a butyl compound suitable for use in 5, 25, and 55 gal. steel drums for the transportation of 60 percent hydrofluoric acid has recently been developed and should have wide application.

Protective Coatings

KENNETH TATOR, *Kenneth Tator Associates, Coraopolis, Pa.*

Hydrofluoric acid above concentrations of 60 percent may be satisfactorily held in passivated mild carbon steel. Hence the use of organic barriers above this concentration serves only to protect the acid from iron contamination. For such uses the thin sprayed and baked phenolics or furanes are suitable.

Anhydrous hydrofluoric acid with its great affinity for water has a degrading effect on most organics by charring or other evidences of dehydration. This effect is most noticeable in those materials having available hydroxyl groups, such as wood, and most resisted by the hydrocarbons, such as polyethylene. Teflon, as might be expected of this fully fluorinated polyethylene, is most resistant and in wide use for gaskets.

At concentrations below 60 percent hydrofluoric acid is highly corrosive. For example at a concentration of 48 percent, it will penetrate a quarter inch steel shell within six months at ordinary temperatures. In the face of this active rate of attack, and in spite of the fact that many organic materials in themselves are adequately inert the use of thin coating films is not advisable as undetected imperfections in the coating film, or subsequent film fracture by mechanical impact will expose the underlying metal and result in rapid perforation. Minimum lining thicknesses of ⅛ in. are desirable for production equipment, and where the selected lining does not possess adequate resilience to resist mechanical impact a carbon brick overlining should be installed.

For all concentrations below 98 percent and temperatures below 350 deg. F. the filled phenolics are in successful use. Filled furanes are also satisfactory. Filling materials of asbestos and silica and glass fabric reinforcement should be avoided. Carbon filled material is suitable.

Of the rubbers, hard or semi-hard material rubber is being successfully used at concentrations up to 40 percent and temperatures up to 150 deg. F. The use of soft natural rubbers should be restricted to concentrations below 30 percent. Neoprene is the preferred rubber, in satisfactory use for concentrations up to 60 percent and temperatures up to 150 deg. F. Butyl rubber is equally suitable except for its lower temperature limits, 130 deg. F. Indifferent success is reported with buna S and N.

The thermoplastics—polyethylene, polystyrene, methacrylates, and vinyls—have all been used successfully within their temperature limitations, below 120 deg. F., at concentrations up to 60 percent. In the case of the vinyls, which resin is resistant, commercially available vinyl linings vary considerably in the type and amount of plasticizer and stabilizer. Inquiry or tests should be conducted to insure that these compounding materials are also resistant.

The Pennsylvania Salt Manufacturing Co., on whose experience this report has been verified, has standardized wherever possible on carbon brick linings over neoprene membrane, the former set in carbon-filled phenolic cement. (NOTE: *Pennsalt is one of the leaders in the study and production of fluorine and fluorine compounds.*—Editor).

Not Recommended

Chemical Stoneware

Chemical stoneware, in common with all siliceous products, is not suitable for use with HF under any conditions.—F. E. HERSTEIN, *General Ceramics Co., Keasbey, N. J.*

Tantalum

Tantalum is very rapidly attacked by hydrofluoric acid.—ALLAN L. PERCY, *Fansteel Metallurgical Corp., North Chicago, Ill.*

Glass-Lined Steel

Since present glass linings are based primarily on silicates, they are not recommended for use with hydrofluoric acid under any conditions. —S. W. MCCANN, *The Pfaudler Co., Rochester, N. Y.*

Aluminum

Hydrofluoric acid solutions are generally recognized as good etchants for aluminum; accordingly, aluminum alloys would not be selected as materials of construction for equipment to handle hydrofluoric acid.—ELLIS D. VERINK, JR., *Aluminum Company of America, New Kensington, Pa.*

NEXT MONTH . . .
. . . Symposium on Fluorine

Tough, lumpy superphosphate is readily picked up and carried to grinders.

RECEIVING—Up to 8 boxcars of superphosphate, potash, sulphate of ammonia, etc., are unloaded each day. One operator can unload a 50 ton car in 2 hours, using a narrow 5½ foot dock and carrying 55 ft. to a chute. Truckloads of incoming meat scraps and bones dumped in the yard are scooped up and carried up a ramp into the plant bins by the Payloaders.

PRODUCTION — The fifteen different kinds of materials going into the products vary in nature—dusty, sticky, lumpy, fine, hard, dry and slippery—yet all are handled and rehandled readily by the Payloaders, which scoop them up from their bins and carry and feed them into conveyors, grinders and batchers.

MISCELLANEOUS — The versatility of Payloaders is valuable for the miscellaneous handling jobs that abound at this plant ... clean-up work ... snow removal ... loading trucks and cars ... handling oil drums ... moving, lifting, loading and dumping of different materials.

"THERE'S *Just No Limit* TO THEIR USE"

5 Payloaders Serve Every Phase of Operations at Independent Manufacturing Company

This Philadelphia plant makes fertilizer, fertilizer bone meal, meat scrap feed, etc., and has a total of 5 Model HA Payloaders with 10½ and 12 cu. ft. buckets. They were selected because they provided a flexible material handling system, combining the abilities required to operate inside a boxcar . . . dig and lift full bucket loads of the densest, hardest materials . . . transport them speedily indoors, outdoors and up ramps . . . dump them where wanted without manual help.

Company officials estimate that each Payloader does the work of a six man crew — without complaint. They say, "There's just no limit to their use. When you consider that all our materials are handled two or three times you can readily picture the savings made by our PAYLOADERS."

PAYLOADERS are unique in name, in design and in proven ability to save time, labor and costs on bulk material handling. It will pay you to get full facts. The Frank G. Hough Co., 702 Sunnyside Avenue, Libertyville, Illinois.

The entire batch of meat scraps is fed to the conveyor in a few minutes.

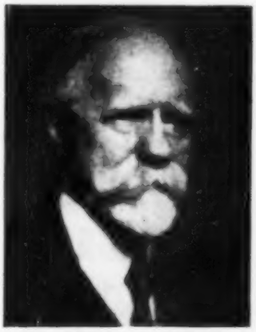
GET YOUR COPY OF Job Study No. 13 — a complete authorized analysis of Payloader operations at this plant. IT'S FREE!

HOUGH PAYLOADER

SAY HUFF

Manufactured by THE FRANK G. HOUGH CO.

Names in the News



MAN OF THE MONTH

W. B. Bell

A few days after you read this the American Section of the Society of Chemical Industry is going to honor one of America's outstanding industrialists. William Brown Bell, president of American Cyanamid Co., is to receive the Chemical Industry Medal for 1949 for outstanding contributions to the advance of chemical industry.

Mr. Bell was elected to his present position 27 years ago. Under his direction Cyanamid has grown to a company with 40 plants and 17,000 employees serving 200 industries. This growth has been due to his foresight. He saw the need for diversification accomplished by internal growth and direct purchase. Mr. Bell says of the company, "In 1922 the fertilizer business of American Cyanamid Co. was depressed—its phosphate rock mines in Florida were shut down. Its Ammo Phos plant in New Jersey was shut down. Its cyanamid plant at Niagara Falls was operating at 14 percent of capacity. That was all and any fool could see that what we needed was diversification."

He also believed in expanding the company's interest and investment in research. It was his leadership that built up great research organizations at Stamford, Pearl River and Bound Brook covering all the fields from pure research to technical service and pilot plant work.

His beliefs paid off.

Friends and associates of Mr. Bell are continually impressed by both his boundless energy and his capacity for work. He is no swivel-chair administrator. He visits plants, mines and laboratories. He knows what is going on. And he is a stickler for safety. He is interested in his employees—their welfare, pensions, problems.

Apart from Cyanamid he is active in other fields. He is honorary vice president and a member of the board of NAM; was president of MCA for three years; was president of the Chemical Alliance for five years; is a trustee of Haverford College as well as the Duke Endowment Fund; is a director of the Sloan Foundation. In 1936 he was chairman of the finance committee of the Republican party. All his life he has devoted a great deal of his time to the preservation of the free enterprise system and the American way of life.

His work is both vocation and avocation. A second hobby, however, is yachting. This interest was climaxed in 1928 with the winning of the King of Spain's Cup Race. He sailed his 96-ft. schooner Elena from New York to Spain in less than 17 days.

The SCI is honoring a lawyer turned industrialist, a businessman who knows more chemistry than many chemists, a leader who has served his company and his country.

Miller W. Conn has been appointed assistant manager of Phillips Petroleum Co.'s chemical products department in Bartlesville, Okla. **Dale Fischbeck** succeeds Conn as service engineer of the company's Perco division.

Raymond B. Cross has been made manager of the Paulsboro catalyst plant of Houdry Process Corp.

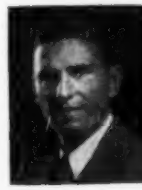
Francis R. O'Brien has been appointed head of the engineering division of Southern Research Institute, Birmingham, Ala. Mr. O'Brien was formerly with the University of Alabama as director of the Engineering Experiment Station.

E. D. Anderson has been made chief engineer in the heat exchanger division of the Western Supply Co., Tulsa, Okla.

S. J. Rini has been appointed chief of the fat and oil research section of the Kraft Foods Co.'s research staff. He was formerly on the research staff of Lever Bros.

Jack Compton has been appointed head of the chemistry department of the Institute of Textile Technology at Charlottesville, Va.

John Happel is the new chairman of the department of chemical engineering at New York University's college of engineering. Dr. Happel has been professor of chemical engineering at the college for a little more than a year. Prior to that he was a chemical engineer with the Socony-Vacuum Oil Co. for 18 years.



J. Happel

K. Kammermeyer

Karl Kammermeyer has been appointed professor of chemical engineering and head of the division of chemical engineering of the University of Iowa, Iowa City, Iowa. He was formerly manager of research and development of the Glenn L. Martin Co.

Alfred G. Susie, formerly chief chemist at Marbon Corp., Gary, Ind., has been appointed supervisor of plastics research at Armour Research Foundation of Illinois Institute of Technology.

Bernard Rudner has joined the technical staff of the Rensselaer, N. Y., plant of General Aniline & Film Corp.

William F. Hester, former director of insecticide and fungicide research of the Rohm & Haas Co., Philadelphia, has been named administrator of the fellowships of Koppers Co., at Mellon Institute.

Bernard F. Langer has been made manager of structural and heat engineering for Westinghouse Electric Corp.'s atomic power division. **Erling Frisch** has been made manager of control engineering.

W. R. Graham, Jr., has been named director of research by the Quaker Oats Co., Chicago, to supervise

(Continued)

chemical, pharmaceutical, and nutritional research. Dr. Graham had been with Cerophyl Laboratories, Kansas City, Mo.

J. W. Britton has been appointed head of the new technical service division of Surface Chemicals, Inc., Pittsburgh, Pa.

Mearl A. Kise has been named director of research and development of the Virginia Smelting Co., West Norfolk, Va. Mr. Kise was formerly assistant chief of research for the Solvay process division of the Allied Chemical and Dye Corp.

M. A. Kise

N. H. Parker

Norman H. Parker has joined the Robinson Brothers Chemicals, Inc., staff as superintendent of the company's Brooklyn, N. Y., plant. He was formerly associated with the National Lead Co. research laboratories.

E. W. Luster has been appointed manager of the Esso engineering department of Standard Oil Development Co. **C. E. Paules**, formerly associate chief engineer, succeeds Mr. Luster as chief engineer of the department.

James P. Fugassi, professor of chemistry at Carnegie Institute of Technology, Pittsburgh, Pa., has been appointed acting head of the department of chemistry.

F. Curtis Tucker, formerly assistant purchasing manager of the Rohm & Haas Co., has been appointed manager of purchases for the chemical division of the General Electric Co., Pittsfield, Mass.

J. Earl Harrington has been appointed executive secretary of the Western Society of Engineers.

George R. Greenbank of the United States Department of Agriculture has received the Borden Award in the Chemistry of Milk presented by the American Chemical Society. The society has also presented the new

(Continued)

Precision Scientific Co. Award in Petroleum Chemistry to **Bruce H. Sage**, professor of chemical engineering in the California Institute of Technology.

Robert D. Coghill, director of research of Abbott Laboratories, North Chicago, Ill., has won the 1949 Midwest Award of the St. Louis section of the American Chemical Society.

William B. Brown, former research director for Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has been named general superintendent. **James E. Sincell** and **Wallace A. Shelby** have been named assistant superintendents. **R. E. Christ** has joined the research staff as director of plasticizer development. **John E. Sigler** has joined the staff to work on problems of air and water pollution.

W. B. Brown

J. D. Heldman

Julius D. Heldman has been transferred to the research laboratory at the Houston refinery of Shell Oil Co. He was formerly chief research chemist at the company's Wilmington laboratory.

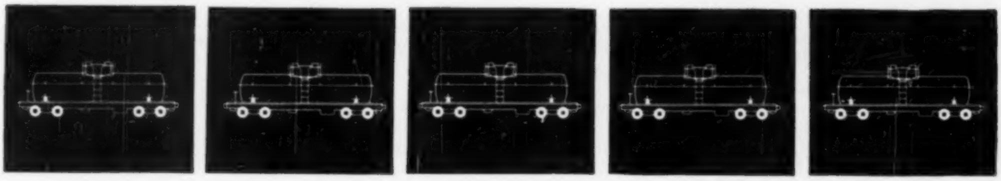
J. A. Almquist and **R. L. Hershey** have been named assistant general managers of the polychemicals department of Du Pont. The polychemicals department is the result of a consolidation of the ammonia and plastics departments.

Hayden H. Jones, Jr., **Norman D. Phillips** and **Earle F. Young, Jr.**, have joined the chemical laboratory of the research and development department of Babcock & Wilcox Co., Alliance, Ohio.

John H. Rollins, formerly on the staff of the Chemical Corps School, Army Chemical Center, Md., has been assigned as chief of the technical services division, Technical Command, Army Chemical Center. **Robert J. Classen** has joined the

(Continued)

pure, uniform caustic soda



to meet your strictest requirements

Wyandotte Caustic Soda, as produced by the Mercury Cell method, meets the highest standards of quality. Commercially, it is free from sodium chloride, sodium chlorate, iron and practically all other impurities.

In the manufacture of rayon and other products—wherever high-grade caustic soda is essential—this truly fine chemical can be used as delivered, without further processing. Its purity and uniformity do not depend upon the efficiency of a purification system.

Recently completed facilities have enabled us to double our previous production of Mercury Cell Caustic. If your chemical needs include quality caustic soda, why not write us today?

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BICARBONATE OF SODA
CALCIUM CARBONATE • CALCIUM CHLORIDE
CHLORINE • HYDROGEN • DRY ICE
SYNTHETIC DETERGENTS • GLYCOLS
ETHYLENE DICHLORIDE
PROPYLENE DICHLORIDE • CHLOROETHERS
AROMATIC SULFONIC ACID DERIVATIVES
OTHER ORGANIC AND INORGANIC CHEMICALS

Wyandotte
REG. U. S. PAT. OFF.

Air Force Munitions Branch, munitions division, as a chemical ordnance engineer.

Ernest D. Wilson, head of the department of chemical engineering and chemistry at Worcester Polytechnic Institute has been appointed to the board of registration for professional engineers for Massachusetts.

Robert E. Wagner has been appointed assistant professor of chemical engineering at Worcester Polytechnic Institute, Worcester, Mass. **John H. Beckwith** and **Leonard W. Fish** have been appointed graduate assistants.

Henry O. Pond, district purchasing manager with the H. K. Ferguson Co., has reentered the private practice of consulting engineering. He will retain connection with H. K. Ferguson in a consulting capacity.

Arnold H. Johnson has been named director of research at National Dairy Research Laboratories Inc., Oakdale, L. I.

Ray H. Moore has joined the staff of the Claude B. Schneible Co. as a special consultant.

Robert A. Harte has been appointed research administrator, medical research division, Sharp & Dohme, Inc., Philadelphia.

Frank J. Aschenbrenner and **Earl C. Clark** have been appointed assistant directors of research and engineering for Air Reduction Sales Co. Mr. Aschenbrenner will be in charge of the Air Reduction Murray Hill, N. J., laboratory.

C. V. Mace and **John M. Blickle,** chemists, have been added to the staff of the applied physics laboratory of Johns Hopkins University, Silver Spring, Md.

Morris A. Steinberg has been elected to the board of directors of Horizons Inc. of Princeton, N. J.

W. H. Sheffield, Jr., has been elected president and general manager of Innis, Speiden & Co., New York. He succeeds his father who died recently.

George E. Holbrook has been named assistant director of the technical division of Du Pont's organic chemicals department in Wilmington. **John E. Cole** will replace Dr. Hol-

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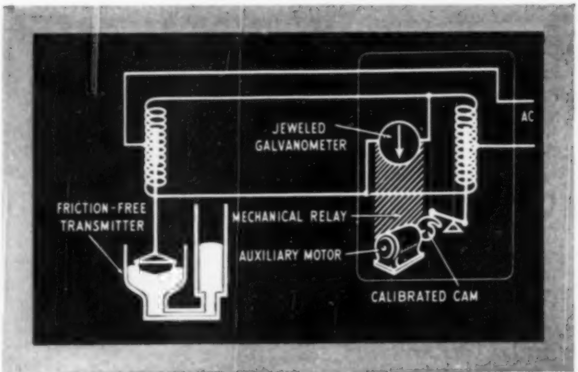

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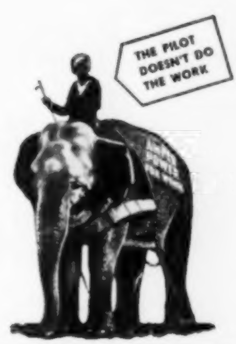
HAYS-PENN Flow Meter

Extreme accuracy *that stays accurate* is the chief characteristic of the Hays-Penn Flow Meter; and the "reason why" is exceedingly simple:

- the friction-free float transmitter serves only as a pilot—does no work of recording—actuates the auxiliary motor which does the work of operating the recording pen, indicator and integrator



No stuffing boxes, no bearings, no electric contacts, no solenoid reactions—that is why Hays-Penn Flow Meters maintain their matchless accuracy through long periods with a minimum of maintenance. Hays-Penn Flow Meters are made for every metering need.

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brook at the company's Chambers works at Deepwater Point, N. J. **Edgar W. Thompson** has been named manager of the neoprene chemical rubber plant at Louisville, Ky., to replace **Emory F. Ridlon** who has been placed in charge of tetraethyl lead manufacture at the Chambers works.

John T. Castles has been made manufacturing engineer of General Electric's silicone plant in Waterford, N. Y.

Philip Heiberger has been appointed senior lacquer chemist of the Stamford, Conn., branch of Atlas Powder Co.'s industrial finishes department.

Martin Kuna has been added to the staff of the department of antibiotic research of Sharp & Dohme, Inc., Philadelphia. **Peter A. Tayormina** has joined the department of biochemical research.

Edgar Collins Bain, vice president in charge of research and technology at the Carnegie Illinois Steel Co., has been awarded the John Price Wetherill Medal of the Franklin Institute of the State of Pennsylvania.

James J. Doheny has been appointed manager of the Chicago section of the American Chemical Society.

Hendley Blackmon, formerly managing editor of *Electrical World*, has been appointed assistant manager of engineering association activities for Westinghouse Electric Corp., Pittsburgh, Pa.

James R. Harrington has been appointed assistant branch manager of the Cleveland, Ohio, office of Monsanto Chemical Co.'s phosphate division. **Howard Lovejoy** has become assistant branch manager of the Birmingham, Ala., sales district. **Lloyd D. Shand** has been made a sales representative in the company's New Jersey territory for the Merrimac division.

Paul M. Isbill has been appointed assistant general manager (administration) of the Texas Co.'s domestic sales department. **S. C. Bartlett** has been named assistant general manager (sales).

Edward H. Wyckoff, Texas sales manager of Diamond Alkali for the last 15 years, has resigned to go into business for himself. He has or-

(*Continued*)

ganized the Texas Chemical Supply Corp. at Houston. The new corporation will be jobbers of heavy chemicals, cleaning compounds, absorbent materials and industrial maintenance supplies.

C. Victor Mars has been named manager of the new product department, Ansul Chemical Co., Marinette, Wis. **Robert J. Yaeger** succeeds Mr. Mars as sales manager of the industrial chemical division.

Robert B. Reynolds has been transferred from the San Francisco office of Taylor Instrument Cos. to Chicago where he has been made assistant manager.

Harry W. Fieberts has been added to the development engineering staff of Lukens Steel Co., Coatesville, Pa., as a sales engineer to specialize in paper machinery.

Shelby A. McMillion has been appointed assistant to the vice president in charge of sales, Chicago Metal Hose Corp., Maywood, Ill. **T. K. Wells** has been appointed assistant to the vice president in charge of sales. **E. L. Hiter** has been made manager of sales for the Eastern division and **A. W. McGuire**, manager of sales for the Western division.

J. K. Hamilton has been named manager of apparatus research division, Air Reduction Sales Co., at the research laboratory in Murray Hill, N. J., **H. O. Klinke** has been made assistant manager. **J. T. McKnight** has been appointed superintendent of production and services section and **T. J. Cholis** has become supervisor of patent section.

Orum R. Kerst has been placed in charge of the northeastern sales district of E. F. Houghton & Co., Philadelphia. **J. R. Clendenning** has been placed in charge of the southeastern district.

Malcolm S. Adler has been made district manager for the Cleveland office of the F. J. Stokes Machine Co., Philadelphia. **John C. Meyer, Robert Platt** and **Richard V. D. Strong** have been made managers at San Francisco, Philadelphia and Chicago, respectively.

Charles E. Sharp has been made Chicago branch industrial manager for Brown Instruments division of Minneapolis-Honeywell Regulator

(Continued)

NAMES IN THE NEWS, *cont.* . . .

Co. **John A. Robinson** has been named regional sales manager for the Midwest, Northwest, Rocky Mountain and Pacific Coast areas. **Charles D. McIntire** has been named industrial sales manager of the Cincinnati branch office. **John E. MacConville** has been named industrial sales manager of the Atlanta branch.

Frederick A. Fielder has been appointed general manager of the Bar-Way Co. of Stamford, Conn.

Eric G. Peterson has been made general manager of Peabody Engineering Corp., New York.

J. H. Sheehan has been appointed manager of all petroleum sales for Lion Oil Co., El Dorado, Ark. **Leroy Donald** has been made administrative assistant (chemical sales) to the vice president.

R. J. Caccavelli has been made manager of the Superior Electric Co., Bristol, Conn., Chicago sales office.

T. R. McGovern has been appointed to handle heating and ventilating products in the Los Angeles territory for Modine Mfg. Co., Racine, Wis.

Arnold R. Beardsley has been put in charge of sales of the Takamine Laboratory, Inc., Clifton, N. J.

Robert L. Allen has been made district manager of the Cleveland office of Fritz W. Glitsch & Sons, Tulsa, Okla. **Allan Persson** has been made manager of the Chicago office.

Carl K. Mead has been appointed assistant to the sales manager of the chemicals division of General Electric Co., Pittsfield, Mass. **Harold G. Deters** succeeds Mr. Mead as sales manager of alkyd resin products.

Kenneth H. Mac Watt has been appointed director of engineering sales of L. O. Koven & Brother, Inc., Jersey City, N. J.

John H. Selby has been made sales representative in New Orleans for Oronite Chemical Co.

Kasper Peter has been made manager of the Chicago district of Phillips Chemical Co.'s fertilizer sales division. **Harold R. Krueger** has been made director of the division's technical service. **Clarence J. Ball** has

(*Continued*)

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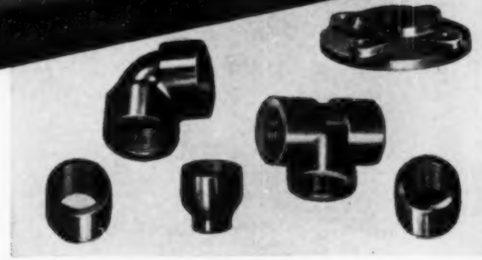
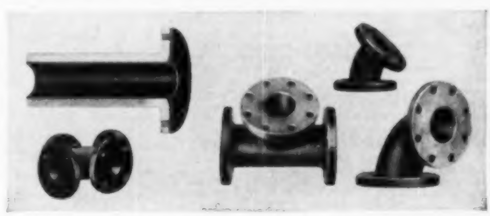
Here's the most complete line of hard rubber and plastics pipe and fittings you'll find anywhere. Ace hard rubber resists all alkalies, metallic salts of inorganic acids, hydrochloric acid any strength, nitric acid up to 16° Baume, phosphoric acid to 75%, sulphuric acid up to 50° Baume, most other inorganic acids any strength, and countless other corrosive solutions and fumes. Other Ace plastics such as Saran and Parian (polyethylene) extend this range of applications still further. Catalog 300-7 and Ace plastics bulletins tell you where Ace-clad and Ace molded equipment saves for you—send for them today.



SARAN and PARIAN: Tough, exceptionally resistant pipe and fittings of Saran and Parian (polyethylene) plastics. Sizes ½, ¾, 1, 1¼, 1½ and 2". Complete variety of fittings. Standard pipe threads. Also Saran tubing and tube fittings from ⅛ to ¾".



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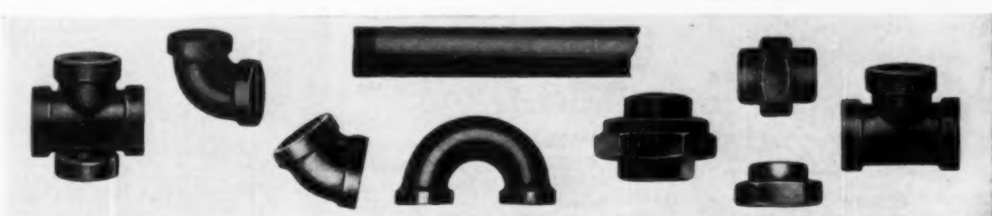

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been made manager of the Norfolk, Va., district. **R. D. Evans** has been appointed manager of the Houston district. **A. Wayne Peck** has been made sales representative in the anhydrous ammonia section with headquarters in Bartlesville, Okla.

C. Benson Branch has been named manager of the technical service and development division of Dow Chemical Co., Midland, Mich.

Richard J. Both has been assigned to special duties in the insecticide division, Hercules Powder Co., Wilmington, Del. **James H. Neal** has succeeded Mr. Both as toxaphene technical service and sales representative in the Southeast.

Fred W. Fuller has joined the Claude B. Schneible Co. to serve as a specialist for the dust and fume equipment industries.

W. E. Conkright has been made sales promotion and advertising manager of the General Controls Co., Glendale, Calif.

F. S. Mott has been made manager of manufacturing at the Ridgway, Pa., division of the Elliott Co.

Frank X. Banko has joined the Radio Frequency Laboratories, Inc., Boonton, N. J. as assistant sales manager. **William W. Follin** has been made field engineer for the Washington, D. C., area.

L. E. Pennington has been appointed the representative to the petroleum industry for the Reynolds Metals Co., Louisville, Ky.

Charles C. Brooks has been appointed southeastern representative of the Pressed Steel Tank Co., Milwaukee.

H. F. Whitler has been appointed sales manager of the fatty acid department of the chemical division of Armour and Co., Chicago. **Robert S. Haley** has been made assistant sales manager. **K. E. Johnson** has been appointed sales manager of the derivative department.

John C. Toomey has been made a district sales engineer in the Detroit office of Chain Belt Co. of Milwaukee.

George E. Hardy has been appointed to the pharmaceutical sales staff

(Continued)

of Dow Chemical Co., Midland, Mich.

Samuel B. Applebaum has been made manager of the cold process water treating division for the Cochrane Corp., Philadelphia.

David H. Jackson has been made general manager of Croll-Reynolds Co., New York.

Paul Hexter, vice president in charge of sales of Arco Co., Cleveland, has resigned.

John B. Hayes has been appointed sales representative for the electrode division of Great Lakes Carbon Corp., Niagara Falls, N.Y.

OBITUARIES

T. L. B. Lyster, 70, former chief engineer of the Hooker Electrochemical Co., Niagara Falls, died August 18 of a heart ailment after a short illness.

Alphonso L. Ivey, 65, president and general counsel of the Virginia-Carolina Chemical Corp., died on August 18.

Walter G. Scharmann, 45, a senior engineering associate in the development division of Standard Oil Development Co., died in Westfield, N.J., August 24.

George F. Kroha, 50, vice president and general sales manager of the Pfaudler Co., died August 31 in Cleveland, Ohio.

A. Donald Cummings, 45, for the past 13 years chief chemist of the Collyer Insulated Wire Co., Pawtucket, R.I., died in Providence on September 1.

Charles W. Cuno, consulting chemical engineer of St. Louis, Mo., died September 9.

Edward Ledoux, an engineer formerly with the Attapulgus Clay Co. of Philadelphia, and author of several books on adsorption and numerous articles for *Chemical Engineering*, died on September 18 at Latrobe, Pa., where he made his home.

Sterling Diggs, 69, died last month in his home at the University of Virginia in Charlottesville. Before his retirement, he had been a chemist for the Standard Oil Co.

INDUSTRIAL NOTES

Standard Oil Co. (Ohio) has announced that Sohio has engineering work under way that may lead to the construction of a $4,000,000 crude oil distillation unit in Cleveland. Plans are also being discussed for an increase in the capacity of the catalytic cracking plant at the Cleveland refinery.

Pan American Petroleum Corp. of New Orleans has merged with its subsidiary, Root Petroleum Co. of Shreveport, La., to form Pan-Am Southern Corp. President of the new corporation will be Bruce K. Brown, now president of Pan American Petroleum Corp.

Magnolia-Airco Gas Products Co. is now carrying on the business formerly conducted by Air Reduction Sales Co. in the southwest region of the United States.

Container Corp. of America, Chicago, has announced that its subsidiary, California Container Corp., has leased the folding carton machinery and equipment of the Bemis-Jason Co., San Francisco. Bemis-Jason will continue to manufacture its line of corrugated specialties at its present location.

Metal Hydrides Inc., Beverly, Mass., has completed additional units for the manufacture of lithium aluminum hydride. This material, heretofore confined to laboratory and research quantities, is now commercially available.

Bowen Engineering, Inc. has moved its business offices to North Branch, N. J. The company was formerly located in Garwood, N. J.

Ampco Metal, Inc., Milwaukee, has appointed W. P. and R. S. Mars Co., Duluth, Minn., as distributor of its products in northern Minnesota, upper peninsula of Michigan and the northern counties of Wisconsin.

General Electric Co., Pittsfield, Mass., has established a warehouse for servicing midwestern G-E Glyptal alkyd

(*Continued*)

resin accounts at the Decatur, Ill., plant of the plastics division of the company.

Moore Products Co., Philadelphia, has opened a branch office in Los Angeles, Calif. The new office will be headed by H. E. Wheeler.

Western Supply Co. of Tulsa has opened a branch office for its heat exchanger division in the West Bldg. in Houston, Tex., with Frank M. Gibbons as manager.

Detrex Corp., Detroit, has combined its industrial product engineering, estimating, quotations, orders, and customer field services under T. J. Kearney, chief engineer in the equipment division.

General Controls Co., Glendale, Calif., has opened a factory branch office in Cincinnati, Ohio, to service southern Ohio, southeastern Indiana and central Kentucky. It will be headed by Jack Prutow. The Oklahoma City branch office has been moved to Tulsa.

De Laval Steam Turbine Co., Trenton, N. J., has opened a midwestern district office in Chicago. C. C. Bray has been named to manage it.

Harry T. Campbell Sons' Corp., Towson, Baltimore, has appointed new broker distributors. They are: Jensen & McClelland, Chicago; Baker & Collinson, Detroit; Smead & Small, Cleveland; Worum Chemical Co., St. Paul, Minn.; and Pigment and Chemical Co. Ltd., Montreal, Canada.

Mechanical Industries, Inc., has been formed in Pittsburgh, Pa., to be headed by Morton I. Dorfan. The new engineering company will limit its activities to industrial ventilation, smoke, dust and fume control.

Edward Valves, Inc., East Chicago, Ind., has completed new metallurgical, physical, and chemical laboratories. The laboratories will be devoted exclusively to steel valve research.

Russell Mfg. Co., Middletown, Conn., has started negotiations to open a branch plant in Bennettsville, S. C.

Westinghouse Electric Corp., Pittsburgh, Pa., has formed a special products development division that will bring new products from the research to the commercial produc-

(Continued)

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tion stage and will handle special military developments. The division will be headed by Frank W. Godsey, Jr.

Dorr Co. will move its main office, now located at 570 Lexington Ave., New York, to Stamford, Conn., in the Northam Warren Bldg. on Barry Pl.

Graver Tank & Mfg. Co., New York, has established the Graver Water Conditioning Co. as a division of the company to extend the operations which have been conducted by the Graver water conditioning and process equipment department.

Equipment Clearing House Inc. has been formed by former employees of First Machinery Corp. with the cooperation of that company. The new firm will engage in the purchase and sale of equipment for the processing of chemicals, food and kindred products. Offices will be in Brooklyn.

Tamms Silica Co., Chicago, has incorporated under the new name of Tamms Industries, Inc.

Claude B. Schneible Co. has appointed A. G. Hobson exclusive representative for the sale of foundry equipment in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island. His offices will be in Malden, Mass.

Ram Inc., Detroit, has been formed to sell a plastic pressing process to the ceramic industry.

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has opened an office in Tulsa, Okla., for its protective coatings division, to serve the central Midwest. Frank E. McNulty will manage the new office.

Merck & Co., Rahway, N. J., will conduct its export business under the name Merck (North America) Inc.

Borg-Warner Corp., Chicago, has sold its Superior Sheet Steel division plant, near Canton, Ohio, to the Louis Berkman Co., Steubenville, Ohio.

Jas. P. Marsh Corp., Skokie, Ill., has purchased the electrimatic valve division of Simoniz Co. of Chicago.

Union Bag & Paper Corp., New York, has opened a new multiwall bag sales office in New Orleans, La.

—End

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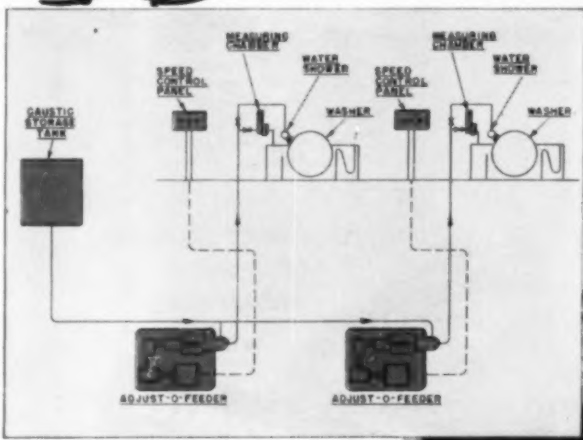

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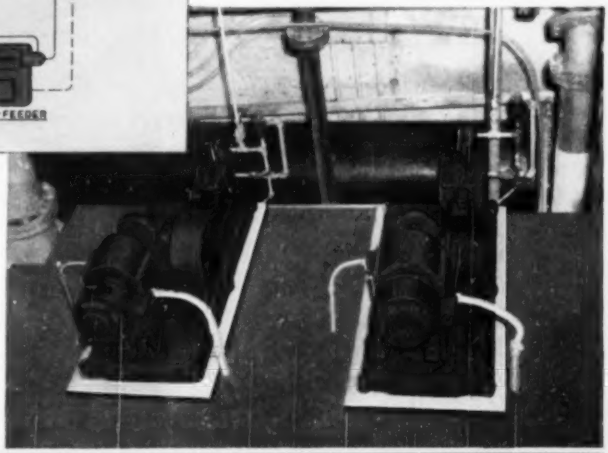

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CONVENTION PAPER ABSTRACTS

Contents

The United Nations has been holding scientific conferences on the conservation and utilization of resources. For Chemical Engineering readers we present abstracts of a baker's half dozen. More next month.—Editor

PETROLEUM

. . . Trends in Oil Chemistry

Leon Jacque

In the past 25 years and the last 10 in particular there has been an increased development in the use of petroleum fractions as chemical raw materials.

This development appears to hold no threat for the conservation of natural resources, as the resulting consumption is very small in proportion to the other uses of petroleum.

The structural features of petroleum have special advantages in regard to chemical operations.

"Oil chemistry" proper consists in the production from petroleum, by cracking, slight structural modification and synthesis, of organic compounds, pure or in simple combination, or of the products of polymerization of the condensation of hydrocarbons.

Although petroleum accounts for perhaps one half of the world organic synthesis industry computable at less than 12,000,000 tons, its corresponding consumption is little more than 1 percent of the total production.

The conversion of natural gas or the gasification of liquid fractions also serves to produce reducing gases—carbon monoxide and hydrogen, with an exceptionally favorable thermic balance; these gases may be used in metallurgy and in organic or mineral synthesis (ammonia). Developments

(Continued)

along these lines are taking place in the United States and in several industrial European countries.

Increasing quantities of methane or liquid fractions are being converted into hydrogen and carbon monoxide. Twenty percent of French natural gas will contribute to the nitrogen industry, and this is likely to increase.

Leon Jacque, French Petroleum Institute, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, May 23, 1949.

CHEMURGY

. . . Promises

Ernst D. Bergmann

It is obvious that from the point of view of modern industry, only such agricultural products are of interest which are obtainable in large quantities and large yields per unit area. The fact that these prerequisites were not fulfilled for most of the natural dyes and drugs was one of the stimuli for research in the synthetic field.

Carbohydrates are being produced by the green plants from carbon dioxide, the end product of all those metabolic and industrial processes which are based on natural carbon compounds, both of the living and of the inanimate world. In using carbohydrates, therefore, we only perform one step in a cycle. In using petroleum or coal, we are destroying irreversibly a material which ultimately was formed by the same forces as the carbohydrates.

A fairly large number of reagents have been employed in the attempt to convert carbohydrates into normal industrial chemicals. Cellulosic materials are said to have been treated on a commercial scale with alkali under high pressure and at high temperature and have thus been transformed into liquid mixtures of hydrocarbons and oxygenated compounds which served as motor fuel.

However, it appears that a much more elegant method for such a conversion consists in the utilization of bacteria instead of chemical reagents. The complicated enzyme systems of the bacterial cell permit the transformation of carbohydrate into a very large number of useful chemicals, useful by themselves or by virtue of their transformability to other products, characteristic of the organic-chemical industry.

Special attention should be given to the so-called acetone-butyl alcohol fermentation which converts starch or

(*Continued*)

sugar into a mixture of acetone, butyl alcohol and ethyl alcohol because these three substances are, at least virtually, hydration products of the three olefines, propylene, butylene and ethylene, on which most of the modern petrochemical processes are based.

Another biological process which appears to hold out great promise, although it has hardly been used industrially, is the methane fermentation, because it gives the possibility not only of producing a fundamental hydrocarbon, but also of basing on carbohydrates all those transformation reactions of which methane is capable. It is of particular interest that the methane fermentation can use cellulose as starting material.

Another distinct advantage of bacterial fermentation is the fact that its results can be influenced, at least to some extent, by modification in the nutrient solution on which the bacteria are acting. This has become particularly interesting in such cases as the production of various penicillins; but a similar effect is known also in the more common fermentations, for instance in the acetone-butyl alcohol fermentation in which an addition of acetate and butyrate to the fermenting mash leads to an increase in the amount of acetone and butyl alcohol produced by the bacterial cell.

It does not appear impossible that systematic application of principles and experience already gained may lead to a revision of current ideas on the paramount value of petroleum and coal, and may thus help in the pacification of a troubled world. In any event, these methods may certainly become a tool in the development of those areas which lag behind in their industrial development and in the standard of living of their population.

Ernst D. Bergmann, Weizmann Institute of Science, Israel, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, August 18, 1949.

CORROSION

. . . *Costs and Control*

W. H. J. Vernon

Hadfield's estimate (1922) of the annual world cost of steel and iron wasted by rusting, of the order of £600,000,000, is well known and frequently quoted. Speculative in large part though such estimates must be, no one can doubt that the aggregate economic loss due to corrosion is enormous, particularly bearing in mind that to the actual loss of metal must

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be added, to complete an economically vicious circle, the still greater amounts of ore, fuel and fluxes used up in its replacement. In many other cases material loss is subordinate to the wastage of time and effort for which corrosion is responsible.

Estimates of corrosion economics are probably more safely applied to the cost of protective measures, particularly if the field be restricted geographically. From a statistical analysis of the total wrought iron and steel production of the United Kingdom for 1936, Hudson deduced the approximate total surface area and concluded that if the whole of this area had been painted with two coats of paint, approximately 32,000,000 gal. of paint would have been required, representing a total cost, including that of the necessary labor, of £40,000,000. Revised figures (1949) place the total cost of corrosion prevention of iron and steel for the United Kingdom alone at the startling figure of £200,000,000 annually.

It should be borne in mind, however, that wastage of metal is by no means the only economic factor to consider. Frequently, corrosion may lead to heavy losses of other materials or heavy increases of power necessary to maintain supplies. An important example of this indirect effect is the reduction of carrying capacity of pipes through the formation of insoluble corrosion product. In many other cases material loss is subordinate to the wastage of time and effort for which corrosion is responsible.

Foodstuffs and other packaged goods are contaminated by corrosion products, water and gas are wasted by leakage, chemical processes are impeded, structural safety factors are augmented, and throughout industry there is loss of efficiency, risk of breakage or explosion, and all the consequent elaborate and costly routine of periodical inspection. In other words, the aggregate cost of corrosion control has probably increased relatively to that of corrosion. On this question, much depends upon the life of the structure as determined by factors other than corrosion, and the initial cost of protection must be balanced against the number of years the structure is expected or required to last.

Measures such as phosphate treatments which increase the adhesion of the paint are clearly advantageous, since in general they contribute to both objects. On the other hand, in the chemical industry, the prolongation of the life of a vessel is clearly of major importance and relatively ex-

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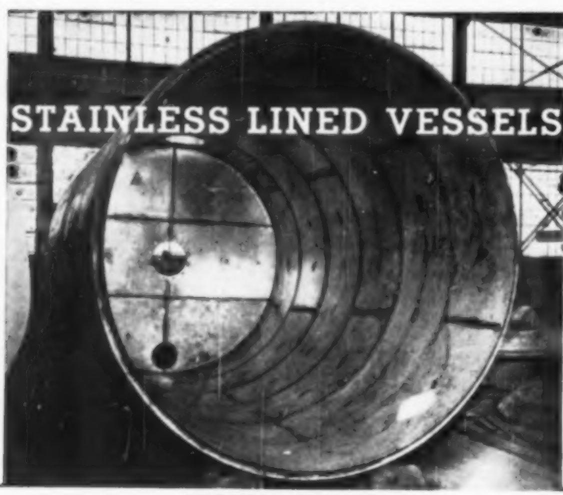

pensive methods of protection become economically practicable; for example, stainless steels may take the place of cheaper materials as a substantial ultimate economy.

Another matter of considerable importance is that of accessibility. Thus, expensive protective methods which may not be justified where parts of the structure can be easily reached for periodical maintenance may become economically expedient and highly desirable if access can be gained only by the expenditure of much time and effort. Underground pipelines afford a good example.

Emphasis has so far been placed upon the metal. Consider for moment a major economic aspect of environment. It is noteworthy that the corrosivity of the atmosphere is very largely man-made. So far as "natural" factors are concerned, atmospheric corrosivity should diminish as the distance from the sea increases. In so far, however, as the approach is made to towns or to populated areas precisely the reverse obtains and it is in such districts, where most of the world's fabricated metal is concentrated, that corrosion, with all its concomitants, is by far the most severe. We are contributing heavily to the destruction of metal economically as precious as the coal that is consumed or, alternatively, to the cost of preventing that destruction.

W. H. J. Vernon, Department of Scientific and Industrial Research, England, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, June 30, 1949.

CHEMURGY

. . . *Food, Medicine and Fuel*

G. E. Hilbert

The word "Chemurgy" was coined about fifteen years ago to express with convenient brevity a complex idea—the idea of developing new industrial uses for farm commodities, of establishing new crops to supply industrial markets, and of making profitable use of farm wastes and residues. Chemurgic objectives include the development of wider markets for farm-grown materials and the creation of "new riches from the soil."

It appears that modern techniques of food preservation constitute one very important field of chemurgic effort. Converting fruits and vegetables into more stable form by canning, freezing, and other methods lengthens the season and expands the area in which these perishable farm

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products can be made available, thus providing wider markets for the farmer and greater food resources for consumers. It is also a partial answer to some of our most persistent farm-surplus problems—the geographical and seasonal surpluses of perishable crops that often occur in limited areas for short seasons.

The most spectacular recent advances in food preservation have been made in the field of frozen foods. They now make it possible for most housewives in the United States to serve fruits and vegetables of many kinds virtually "field fresh" at any season. One new product, the result of applying a new principle of food preseravation, is frozen concentrated orange juice. Its production this year—some 7 or 8 millions gallons—will consume about 10 percent of the orange crop in Florida, as well as a portion of the California crop. Both grape and grapefruit juices are now processed commercially in this way. The new method of concentration and freezing might be extended with advantage to other fruits, particularly some of those produced in the tropics.

Another development of considerable promise, now in an advanced stage of experimentation, is "dehydrofreezing." This process combines the virtues of quick-freezing fruits and vegetables with the advantages of reduced weight and bulk made possible by partial dehydration. Dehydrofrozen peas, apples, apricots, and other products have excellent flavor and are easy to reconstitute in the kitchen. They occupy only about half the space in frozen storage and have about half the weight of conventionally frozen products. Experimental results show that the additional costs involved in drying are more than offset by savings in packaging, transporting, and storing these new products.

Besides giving us new techniques of food preservation, chemurgy has contributed greatly to our wealth of "creatable resources" through the processing of farm products to obtain starches, sugars, oils, proteins, and other constituents that can be used in the manufacture of foods and feeds and as industrial raw materials. The wet-milling of corn, or maize, and the processing of soybeans and other oilseeds are major chemurgic enterprises of this kind.

Perhaps the most important chemurgic development in the United States during the last few years has been the tremendous expansion in the fermentation industries, which produce antibiotics, feed yeast, vitamins,

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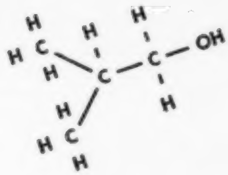
CELANESE

Announces



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industrial alcohol, and other needed products. A great impetus was given to developments in this entire field by the discovery of penicillin and the perfection of methods for the large-scale production of this vital drug by submerged-culture fermentation.

A tremendous amount of work is being done in the United States to develop new and cheaper methods of producing alcohol and to utilize it as motor fuel. Perhaps the most significant development in this field, which may be of interest to many countries, is the use of alcohol as an anti-knock agent in engines by direct, automatic injection into the engine manifolds of automotive vehicles.

G. E. Hilbert, United States Department of Agriculture, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, Aug. 24, 1949.

CONSERVATION

. . . With Heat Pumps

Emory N. Kemler

Utilization of the heat pump in the United States has progressed rapidly during the past two years. There are probably over 150 residential units installed in homes in this country and over 200 units in use in commercial buildings. These vary in size from 550 to 3 hp. Installations have been made in at least 32 states. In those areas where cooling becomes desirable, enthusiastic response to the heat pump has been reported.

The heat pump in the United States has been used as a space conditioning device to give cooling when required, as well as heating. The industrial uses which offer large fuel savings have not developed in this country mainly because of the availability of low cost basic energy in the form of coal, oil or gas.

The future of the heat pump is primarily dependent on the extent and direction of research activities on the various problems associated with it. The most important problem which needs to be solved in so far as the general usage of the heat pump is concerned, is that of heat sources. While no simple and universal heat sources have as yet been developed, there are many possible lines of attack on this problem so that there seems to be little doubt that some development which will solve this need of the heat pump industry will be developed which will make the heat pump a universal type of equipment. Continued

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developments which will result in simplification of equipment and controls, reduction of size and cost, and increase in coefficient of performance are to be expected. These developments will improve the competitive position of the heat pump, result in more satisfactory performance and reduce energy requirements.

Emory N. Kemler, Southwest Research Institute, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, April 21, 1949.

CORROSION

. . . Costs in U. S.

Herbert H. Uhlig

Economic and material loss through corrosion of metals is divided into direct loss resulting from replacement of corroded equipment, and an incalculable, often higher, indirect damage or loss through shut-down, overdesign, loss of product and efficiency, explosion, and contamination.

Direct loss by corrosion, although amenable to analysis, still is difficult to estimate. A survey of this kind is almost always incomplete, and is subject to a wide range of interpretation. Nevertheless, it is believed that annual cost to the United States, amounting to over $5,500 million, represents the present-day tax exacted directly by the ravages of corrosion, and is the correct order of magnitude.

Not all of the material loss can be prevented. Metals persist in reverting to their ores or to compounds of lower energy despite corrosion protection. And possible reduction of economic loss is limited by the continuous or periodic upkeep required of all protective measures notwithstanding, much more can be accomplished through further scientific and engineering application to this problem, involving, as it does, conservation of materials and human effort. Only 1 percent improvement means the saving of 50 to 60 million dollars annually and thousands of tons of critical metals.

Indirect losses are not possible to estimate, and are not subject to even an educated guess. This is particularly true since they include loss of life and limb, and psychological factors attending unpredictable failure or explosion. Furthermore, losses of materials and of dollars and cents through corrosion of industrial equipment seldom become public information.

Large as are these indirect losses, there are also similar losses less readily

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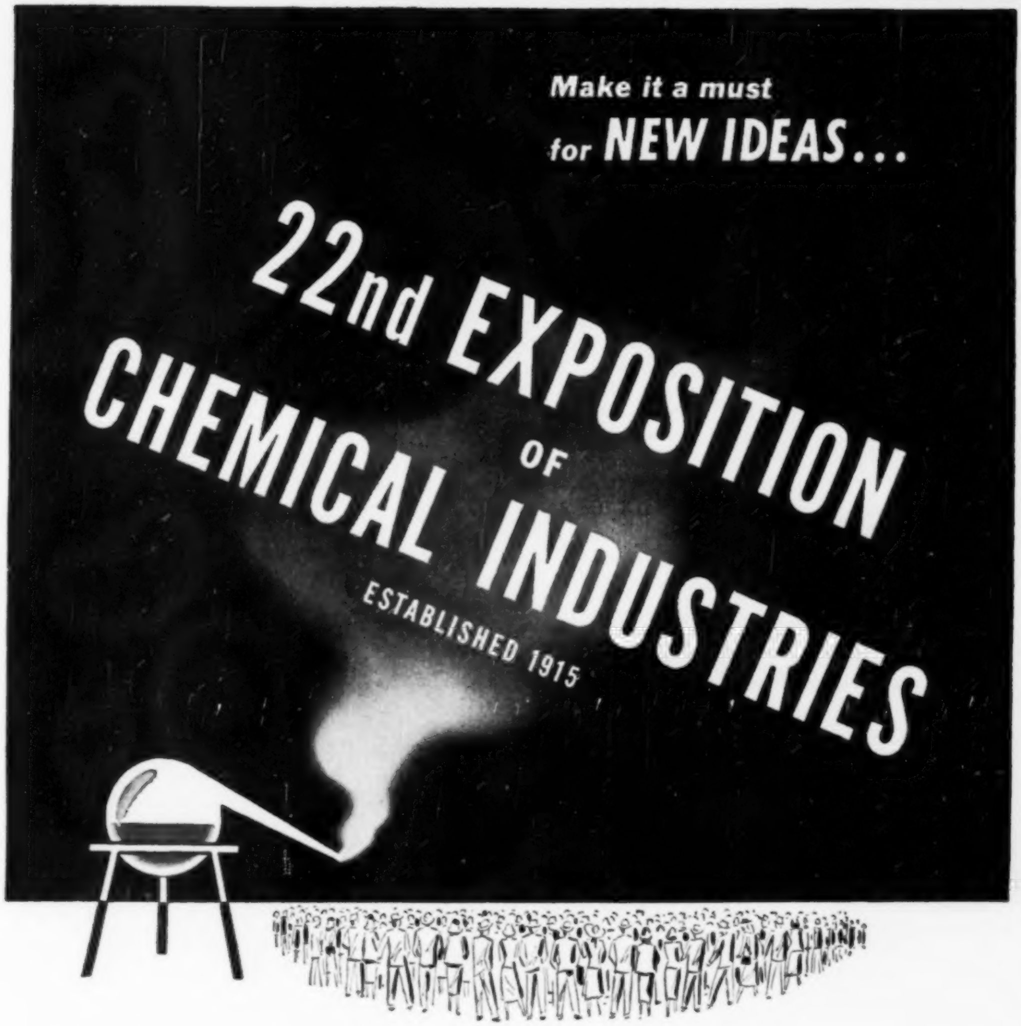

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recognized. For example, appreciable tonnages of metal are consumed needlessly each year because equipment is over-designed to take care of corrosion.

The estimated annual losses are calculated on the basis that all measures which apply to the protection of metals, or which increase the cost of materials over that of steel should be included. Furthermore, labor charges for application or replacement are considered part of the costs.

Herbert H. Uhlig, Massachusetts Institute of Technology, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, May 6, 1949.

CONSERVATION

. . . *Mineral Resources*

H. L. Keenleyside

Optimistic observers point out that there is today no serious or general shortage of any essential metallic or non-metallic mineral product. They recall the way in which discovery has kept abreast of increasing demand in the past, and argue that new discoveries, combined with increased efficiency in methods of processing and utilization, will be adequate to meet any foreseeable future needs.

Those who take the more pessimistic view rightly emphasize that mineral resources, as contrasted with those of the animal and vegetable kingdoms, are wasting assets. They are not replaceable.

As has already been indicated, and as must be constantly recalled, we are hampered in our consideration of this subject by the fact that there are no reliable and complete statistics covering either the extent of our mineral resources or even the rate at which they are being currently consumed.

If we cannot give an adequate estimate of our present resources we may find some significance in an examination of the certain trend of future demands.

There are certain basic factors which are clearly distinguishable. The first of these is the rapidity with which the number of human beings on the earth is increasing. Success in the battle against famine and disease is contributing directly to this result. Not only is the population increasing, it is increasing at an accelerating rate.

A second fundamental factor is found in the almost universal demand for a higher standard of living. This will mean, inevitably, an expansion of the demand for mineral products.

Thus it is quite clear that the com-

(Continued)

bination of an increasing population and rising standards of living will place a strain on our metal resources which will almost certainly in the end prove beyond the capacity of man and nature to supply. It remains to be considered what steps can and should be taken in an effort to prepare for this development.

Our hopes for the future should be directed first towards the discovery of new ore bodies.

It has been said with a great deal of truth that the easy mineral finds have now been made. A review of the discoveries made within the last two decades, particularly in the base metals, reveals only a few of major importance. The lonely prospector with hammer or pan is today a romantic rather than significant figure. In his place the contribution of the scientist must be brought to the rescue of the mining industry.

The greatest hope for fresh supplies of ore depends upon the discovery of new ore bodies in those areas as yet undeveloped. The map of the world shows vast areas of South America, Africa, northern Canada, Asia and Australia, which have not yet been geologically mapped or intensively prospected. New deposits will certainly be difficult to find but with our constantly growing knowledge of the geological and allied sciences it may reasonably be expected that many discoveries will yet be made.

The second step to be taken in our effort to postpone the inevitable date when mineral shortages will develop is the improvement of our techniques of extraction and processing. New and more efficient methods of mining are constantly being sought.

In the future, as higher grades of ore are depleted, more attention must be given to the treatment of complex and low-grade ore bodies by leaching or other chemical methods. Further study must also be given to the possibility of obtaining minerals from sea water.

In addition to the search for new ore bodies and the improvement of our processes of extraction and treatment, greater study must be given to the possibilities of conservation and substitution.

Under the heading of conservation there are two steps of obvious importance. The first is the re-use of metal scrap. Among the more highly industrialized countries scrap today plays a role of real and increasing importance.

The second step in conservation is the prevention of corrosion by the use

(*Continued*)

Changing from batch to continuous processing boosted efficiency, saved valuable space
ANOTHER A.T.&M. SUCCESS STORY BY
Sam Spinner
"RECOVERING SILVER NITRATE FROM PROCESS EFFLUENT IN THESE SETTLING TANKS IS SLOW AND COSTLY, SAM. WE NEED A FAST, CONTINUOUS, SMALL-SPACE PROCESS."
"HMMM... THAT'LL TAKE SOME DOING, BUT I'M SURE I CAN HELP YOU."
"I'VE MOUNTED AN A.T.&M. CENTRIFUGAL OVER A CONVEYOR BELT AND PIPED IN THE EFFLUENT. THE BASKET IS IMPERFORATE AND IS EQUIPPED WITH BAFFLES. THIS SETUP WILL HANDLE THE JOB AS A CONTINUOUS PROCESS."
"A CHEMICAL PRECIPITATES THE SILVER NITRATE AND AS THE BASKET SPINS, IT CAKES AGAINST THE BAFFLES WHILE THE LIQUID IS DECANTED OVER THE TOP. THE CAKE IS THEN PLOWED OUT THE BOTTOM ONTO THE MOVING CONVEYOR."
8 WEEKS LATER
"YOU'VE CURED OUR BIGGEST HEADACHE, SAM. CONTINUOUS CENTRIFUGING IS NOT ONLY MORE EFFICIENT, BUT I RECOVER MORE SILVER NITRATE AND SAVE THE VALUABLE FLOOR SPACE THOSE OLD SETTLING TANKS TOOK UP."
"YOU CAN'T BEAT CENTRIFUGING FOR LOTS OF PROCESSES. A.T.&M. CENTRIFUGALS ARE TAKING OVER MORE AND MORE CHEMICAL JOBS EVERY DAY... AND DOING 'EM FASTER, BETTER, AT LESS COST."
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of preventive coatings of some other metal or of one of the resin compounds, or by the creation of new alloys that resist the corrosive influence of the elements. Much work has already been done in this field but much more remains to be achieved.

Without accepting all of the claims of the chemical fraternity, it is undoubtedly true that over a very wide range of use synthetics can be employed to relieve the pressure on our mineral-resources. It must, however, be recognized that chemicals, which in turn are based on inorganic materials, are employed in the manufacture of these synthetic products. Thus, indirectly, the drain on the mineral resources of the world will continue even though it may be reduced by the use of synthetics.

The situation that is thus developing will make heavy demands on human intelligence and good will. Since no one nation has been endowed with all its mineral requirements, the problem crosses every national boundary. The discovery of solutions is a matter of universal concern.

H. L. Keenleyside, Deputy Minister of Mines and Resources and Commissioner of the Northwest Territories, Ottawa, Canada, before United Nations Scientific Conference on the Conservation and Utilization of Resources, New York, Aug. 12, 1949.

—*End*

FOREIGN LITERATURE ABSTRACTS

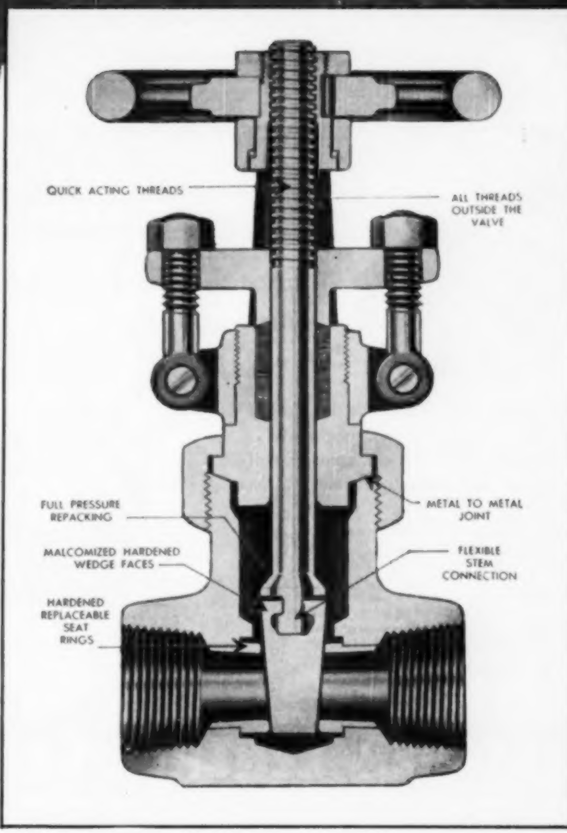
Spongy Divinyl Polymer

Hydrocarbons of the divinyl series, when stored, have a tendency to form a special type of polymer—a white amorphous mass, insoluble in organic solvents and capable of catalyzing the formation of a product similar to itself in the presence of the original hydrocarbon. This polymer is referred to as the spongy polymer or autopolymer. This spongy divinyl polymer has been observed to form (1) at a temperature not exceeding 20 deg., (2) during thermopolymerization of divinyl at 40-60 deg., (3) during polymerization of divinyl in the presence of metallic sodium and carbon dioxide. It has been found that the formation of spongy divinyl polymer is accelerated by introducing most of the metals and

(Continued)

You Can Repack this CHAPMAN LIST 960

UNDER FULL PRESSURE



Here's a rugged, small gate valve you can repack right while it's in use . . . no pressure is transmitted to the stem. Use it in exposed locations, too, for a forged steel packing gland protects the vital yoke threads against rust and corrosion. A recent design feature gives stem and wedge gate connection a more than 50% increase in strength . . . extra protection against even the most extreme operating conditions.

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certain crystalline substances into the divinyl. Formation of spongy polymer was not observed on metallic lead and copper. Spongy polymer forms on iron at practically any temperature of the polymerization process. It has been proved that spongy polymer does not form when oxygen and peroxide compounds are absent in the divinyl and in the apparatus; formation of the polymer is accelerated by peroxides. Activation of the formation of spongy polymer by iron has an adsorption character; this process of forming polymer on iron can be prevented by creating a monomolecular layer of a polar substance on the surface of the iron.

Digest from "Formation of the Spongy Polymer of Divinyl" by K. B. Piotrovski, *Zhurnal Prikladnoi Khimii* **XXII**, No. 5, 518-523, 1949. (Published in Russia.)

Passivation of Iron

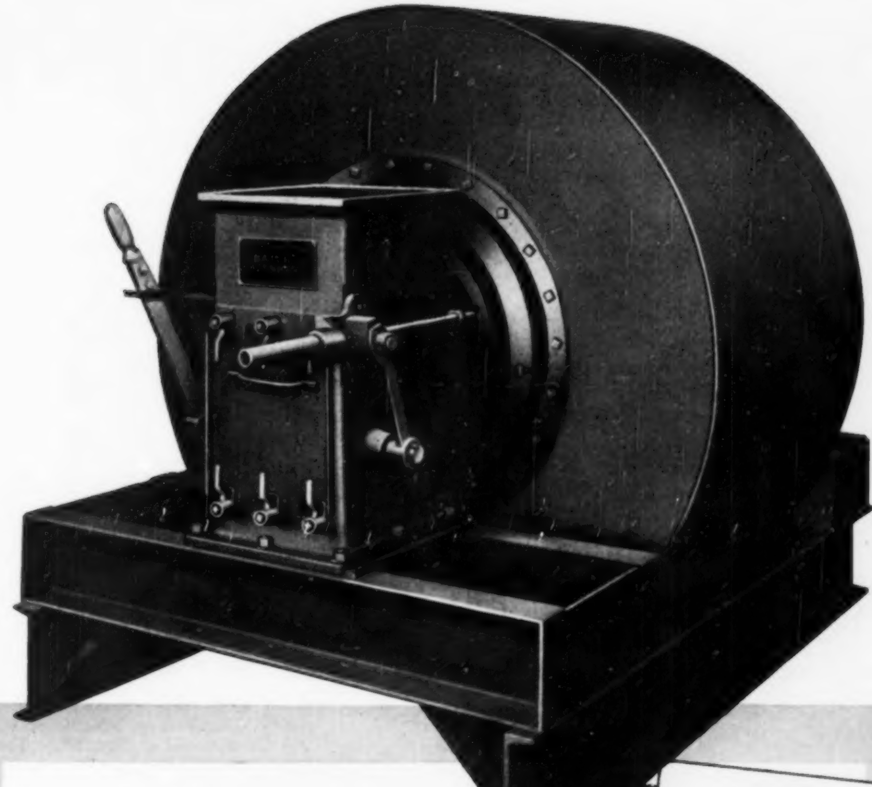
Chemo-adsorption layers of organic compounds have the capacity to passify iron but the effect of such monomolecular layers is not very great due to their thinness and non-uniform distribution on the surface of the metal. Proteins were selected for study of adsorption passivation since they are readily adsorbed on solid surfaces (especially on metal oxides) and can form multilayers and films. Adsorption of gelatin is at its maximum in an acid medium since the minimum surface tension of a 0.5 percent solution of gelatin is at pH 4-4.5. Hydrolysis of gelatin also increases its "adhering" capacity, which is tied in with protolysis of the gelatin. This results in the formation of complicated positive ions which are readily adsorbed on the negatively charged surface of the adsorbent. An acid medium and a negative charge on the surface of the adsorbent are therefore favorable conditions for the adsorption of proteins. Such conditions are provided by mixtures of gelatin and nitric acid. The passivating action of protein adsorption layers is increased by adding phenol and bichromate to the gelatin and nitric acid mixtures. Iron is passivated to solutions of acids by gelatin-nitrophenol chemo-adsorption layers, and to both acids and aggressive salt mediums by means of casein-phosphate chemo-adsorption layers.

Digest from "Adsorption Passivation of Iron by Protein Layers" by G. S. Koshurnikov, *Zhurnal Prikladnoi Khimii* **XXII**, No. 7, p. 698-702, 1949. (Published in Russia.)

Briefs . . .

Molecular Distillation. This process has made great progress in the last decade, particularly through the de-

(*Continued*)



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Receiving — The ingredients to be mixed enter the mixing chamber of drums through a chute. Note scoops which carry up and dump the ingredients as drum rotates assuring a more uniform mix.

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velopment of new pumps and measuring apparatus. This 8-page article deals with the fundamental physical questions in relation to the degree of separation, thorough mixing in the evaporating layer, evaporation process, instability, and energy efficiency. It is accompanied by graphs, tables, and diagrams of equipment and plants.

From "Molecular Distillation" by R. Jaeckel and G. W. Oetjen, *Chemie-Ingenieur-Technik* **21**, No. 9-10, p. 169-176, 1949. (Published in Germany.)

Hydrocyanic Acid. This chemical occurs in coke oven gas as a result of the reaction of part of the ammonia with the incandescent coke. Its content in the gas depends on the coking temperature, height of the oven, water content of the coal charge, and ammonia content. The hydrocyanic acid can be separated from the gas (as the article describes in detail) and used as raw material for the preparation of a number of useful products. Graphs, equations, diagrams and flowsheets are given with the descriptions of these reactions.

From "Hydrocyanic Acid from Coke Oven Gas as a Useful Coal Product" by W. Klempt, *Brennstoff-Chemie* **30**, No. 9-10, p. 148-158, 1949. (Published in Germany.)

Mica. Muscovite is the only mica produced on an industrial scale in the Republic of Argentina. The most important deposits occur in the provinces of Catamarca, Cordoba, San Juan and San Luis. A detailed study was made of the physical and mineralogical properties of this mineral and a number of molecular structure diagrams are included in this 4½ page article.

From "Physical-Mineralogical Study of Mica" by G. Jarnhein, *Industria Minera* **VIII**, No. 90, p. 30-33, 1949. (Published in Argentina.)

Calcium Gluconate. Electrochemical preparation of this product by oxidation of a solution of glucose to gluconic acid in the presence of calcium bromide and calcium carbonate is one of the surest applications of electrochemical oxidation of organic compounds. The authors review various methods of preparation of this chemical. They come to the conclusion that the Isbell process is the most suitable for industrial application. They give a detailed estimate of a plant with a gluconate output of 5 kg. per 24 hr. The article is written in French.

From "Electrochemical Preparation of Calcium Gluconate" by I. A. Atanasiu and G. M. Oprescu, *Buletinul Institutului National de Cercetari Thenologice*, **III**, No. 3-4, p. 400-412, 1948. (Published in Rumania.)

—*End*

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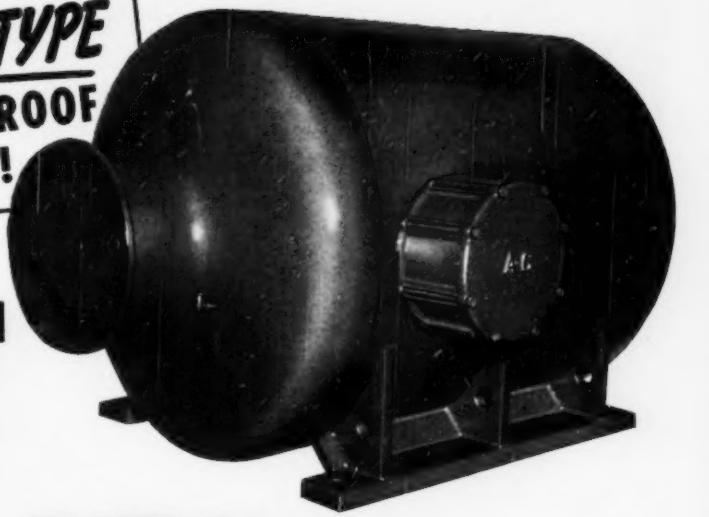
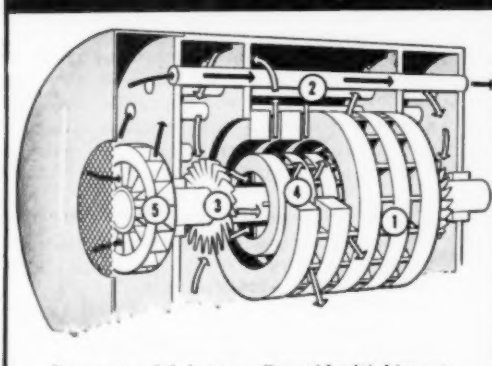


CUT COSTS

IN HAZARDOUS LOCATIONS!

How Tube Cooling Works



Stator core (1) is surrounded by tubes (2). Internal fans (3) circulate air through ducts (4) in rotor and stator and around tubes, transferring heat to tubes.

External fan (5) drives outside air through tubes, removing heat and keeping tubes clean. All electrical parts are enclosed. Dirt cannot enter.

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Some of the more outstanding advantages of JM-3000 Insulating Fire Brick are: It is the highest temperature insulating fire brick made for backup or exposed use, effectively withstanding the full 3000 F. Its efficiency remains at a high level throughout the life of the brick. It has exceptional service advantages in many operations at lower temperatures where regular or special fire brick is ordinarily used.

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Density—63-67 lb per cu ft
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F	500	1000	1500	2000
Btu	3.10	3.20	3.35	3.60

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Chemical Engineer's Bookshelf

LESTER B. POPE, *Assistant Editor*

Carbon (cont'd) to Cinchophen

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. VOL. III. Edited by Raymond E. Kirk and Donald F. Othmer. Interscience Publishers, New York. 955 pages. $20.

You'd better hurry and get your copy of Vol. III, Vol. IV is due to be published next month. Incidentally, the whole set is sold on a subscription basis. Sign up for it if you can. There's nothing comparable in the English language. And that means a lot now that the capitals of chemistry and technology have moved from Europe to America.

Now, about Vol. III. The publisher tells us that C was their toughest letter. It breaks across three volumes: II, III and IV. A had more entries, but C is longer. We can believe that when we note that five subjects account for more than half the pages of Vol. III. [They are: carbon (continued from II), cells (electric), cellulose and derivatives, cement and products, chlorine and compounds.]

The book's other half has everything you need from cathartics, chloroform and chocolate up to an including cinchophen (see analgesics). The articles on carbon monoxide and cement are particularly good. The one on carbon (diamond) sounds authoritative, but it is the only one unsigned —trade secret, I guess.

No one volume of an encyclopedia is complete. Because of cross-references each new volume adds to the value of those already published. The whole will be greater than the sum of its parts.—*LBP*

Too Elementary

FUELS AND LUBRICATING OILS FOR INTERNAL COMBUSTION ENGINES. By B. Pugh and J. M. A. Court. Pitman Publishing Co., New York. 169 pages. $3.50.

Reviewed by Kenneth A. Kobe

This British book deals in an elementary manner with the fuels and lubricants used in internal combustion engines. It was written particularly for "students of aeronautical, automotive and oil engineering and fuel technology, as well as junior members of the staffs of oil companies, the motoring fraternity, and staffs of transport organizations."

All material is elementary from the first chapter on hydrocarbon chemistry written for one who knows little or no chemistry to the final chapter on the meaning and significance of lubricating oil tests, though the integrals and viscosity equations in the latter chapter are incongruous with the general level of the text. The appendix gives both British and U.S. test methods for motor fuels and lubricants. Greases are not included in the book.

The text is so elementary that no chemical engineer or chemist would find the book useful when so many authoritative books exist in this field.

Reactions (Cont.)

ENCYCLOPEDIA OF CHEMICAL REACTIONS. Vol. III. Edited by C. A. Jacobson. Reinhold Publishing Corp., New York. 842 pages. $12.

Reactions of a third section of the elements, taken in alphabetical order, have been collected in the current volume. Elements covered are: cobalt, columbium, copper, didymium, dysprosium, hafnium, holmium, hydrogen, illinium, indium, iodine and iridium. Reactions of the elements' simpler compounds are included.

Since few reactions can be found in the literature under the rarer elements, holmium and illinium are represented by only one reaction apiece whereas the volume contains 822 reactions for cobalt and 610 for copper.

Arrangement of the entries in this volume is the same as it was in the first two (see *Chem. Eng.* Feb. 1946, p. 283; July 1948, p. 284).—FA

RECENT BOOKS RECEIVED

Acetylene Chemistry. By J. W. Reppe. Charles A. Meyer & Co. $10.

Advanced Organic Chemistry. 2nd ed. By G. W. Wheland. Wiley. $8.

The Alchemists. By F. S. Taylor. Henry Schuman. $4.

Chemical Engineering Plant Design. 3rd ed. By F. C. Vilbrandt. McGraw-Hill. $6.

Encyclopedia of Chemical Reactions. Vol. III. By C. A. Jacobson. Reinhold. $12.

Engineering Developments in the Gaseous Diffusion Process. By M. Benedict & C. Williams. McGraw-Hill. $1.25.

Farmer Victorious. By W. J. Hale. Coward-McCann. $3.

Freeze-Drying. By E. W. Flosdorf. Reinhold. $5.

Industrial Hygiene and Toxicology. Vol. II. By F. A. Patty. $15.

Physical Methods of Organic Chemistry. Part I. 2nd ed. By A. Weissberger. Interscience. $12.50.

Scientific Autobiography and Other Papers. By Max Planck. Philosophical Library. $3.75.

Titanium. By J. Barksdale. Ronald Press. $10.

Fruit Processing

CITRUS PRODUCTS. Chemical Composition & Chemical Technology. By J. B. S. Braverman. Interscience Publishers, New York. 424 pages. $9.

Few books have been published exclusively on the chemical composition and chemical technology of citrus products. This is one. For the most part, the author has done a worthwhile informative treatise on a subject he has been associated with for 25 years. Inevitably, there are some personal theories injected throughout the book which to date have not been proved. With these few exceptions only the most recent opinions and structural formulas have been given. The book should prove helpful and informative to food technologists and those engaged in citrus processing.

Section I, given over to chemical composition of the citrus product, sets down what is now known of photosynthesis, properties of the product and the adaptability of these properties. Vitamins present, their importance and methods of detecting them include: (1) Vitamin P, (2) Vitamin A [axerophthol], (3) Vitamin B, [thiamin, aneurin], (4) Vitamin G [B_2 (riboflavin or lactoflavin)], (5) Inositol [$C_6H_{12}O_6$].

Section II, Chemical Technology, is abundant with clearly defined processes, flowsheets, methods and equipment for fruit processing and extraction of citrus oils. The study further deals with processing citrus juices, concentrated, frozen, sweetened, and fermented juices, miscellaneous citrus products and byproducts. In conclu-

(Continued)

sion the author sets forth his own theories on future developments which seems feasible in the citrus product industry: (1) Vitamin C from peel effluent, (2) utilization of peel, (3) converting pectin into Vitamin C, (4) drying by sublimation, (5) frozen jellies, (6) high-frequency and infrared dehydration, (7) direct crystallization of citric acid, and (8) sterilization by ultraviolet and ultrasonics.—*KH*

Poisonous

INDUSTRIAL TOXICOLOGY. Lawrence T. Fairhall. Williams & Wilkins Co., Baltimore. 483 pages. $6.

Reviewed by Morris B. Jacobs

The book is said to have been written in response to many requests for information concerning the toxicity of new as well as old substances of industrial importance. In pursuance of this objective, the author has placed a number of compounds and materials into two large groups. Some 71 inorganic and 134 organic substances and materials or groups of substances are considered in alphabetical order under four principal headings: physical and chemical characteristics, industrial uses, toxicity, analysis. The alphabetical listing has certain advantages and probably greater disadvantages. Thus it seems peculiar to find sulphuric acid listed under hydrogen sulphate and phosgene as carbonyl-chloride and while the isocompounds are considered with the normal compounds, isophorone is placed as is. Thus one finds the dichloro compounds in the middle of the book and the trichloro and tetrachloro compounds at the end of the book. Carbon dioxide, carbon monoxide, and carbon bisulphide are listed with organic compounds but nickel carbonyl is treated in the inorganic group.

There are serious omissions both as to new and old compounds. Thus one finds gallium, lanthanum, rubidium, cesium, and even plutonium but calcium, sodium, and potassium and their oxides are completely ignored as are the alkalis as a class with the exception of ammonia although any one of these is more important industrially. One also finds DDT, benzene hexachloride, and 2,4-D (relatively non-toxic) but many equally important insecticides and herbicides like nicotine, chlordane, chlorates, and some far more dangerous rodenticides like sodium fluoro-acetate and α-naphthyl thiourea are not even mentioned. Among the inorganic compounds space is given to hydrazoic acid, but

(*Continued*)

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In the above view, the welder is attaching a stainless steel lining to the inside of a bubble tower. Note these significant points: (1) a great many welds are needed, (2) the job is difficult and requires skillful welders capable of welding alloy materials with alloy rods.

Therefore, to give you a lining that lasts, the fabricator must have the proper knowledge and facilities for handling these materials. Our welders and technicians are experienced in working with alloys and are familiar with the problems encountered in applying them.

We can also furnish entire vessels made of alloy materials. Our nearest office will be happy to supply information on fabricating corrosion-resistant vessels or linings.

Select both the corrosion-resistant material and the fabrication method for your requirements from this group.

- **Nickel, chrome, and stainless clad steels.**
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Cleveland 15	2220 Guildhall Bldg.	New York 6	3318—165 Broadway Bldg.	Tulsa 3	1623 Hunt Bldg.

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compounds like calcium cyanamide, nitrogen trichloride, and nitrosyl chloride are omitted. Benzine is passed over without mention.

There are some very serious errors in toxicology. Thus the effect of breathing high concentrations of carbon dioxide is *not* "specifically that of asphyxia due to the absence of oxygen" (p. 245) for high concentrations of carbon dioxide paralyze the respiratory center. It is not the fact that "exceedingly small amounts of the gas (carbon monoxide) are dangerous" (p. 249). Propyl alcohol is not more toxic than methyl alcohol as appears to be indicated on p. 4. The introduction of hydroxyl groups into "aromatics" does not necessarily increase the toxicity. Actually the increase of OH groups in aliphatic compounds decreases the toxicity.

The author having had excellent libraries available seems to be under the impression that every analytical chemist has such services and that therefore all he need give in his analytical sections are brief notations of methods or references to the literature as common as *Lab. Pract* (U.S.S.R.) and *Khim. Referat. Zhur.* (re chloroprene, p. 263.). Dr. Fairhall gives fancy methods for the determination of hydrogen sulphide but the simple detector based on silver cyanide which is probably most commonly employed industrially is not listed. The analytical section is wholly inadequate.

There are many other errors; the proofreading is very poor; no medals will be given to the printers for the uneven spacing, cracked and missing letters and high spots; and the publishers cannot be commended for putting out such a poor book.

Recent Books & Pamphlets

Critical Requirements for Research Personnel. Published by American Institute for Research, 1617 Cathedral of Learning, University of Pittsburgh, Pittsburgh, Pa. 66 pages. Observations and records of especially effective or ineffective on-the-job behavior made by those in the best position to observe and evaluate scientific personnel.

Moisture Relations in the Manufacture and Use of Cornstalk Insulating Board. By O. R. Sweeney and L. K. Arnold. Bulletin 163 published by Iowa Engineering Experiment Station, Ames, Iowa. 36 pages. Gratis. Discussion on capacity of cornstalk insulating boards for absorbing moisture when containing varied quantities of initial moisture, when at different depths of immersion, when in atmospheres of various humidities, etc.

Extraction of Soybean Oil by Trichloroethylene. By O. R. Sweeney, L. K. Arnold and E. G. Hollowell. Bulletin 165 published by Iowa Engineering Experiment Station, Ames, Iowa. 89 pages. Records experience with three successive pilot plant units.

A Brief for Corporation Libraries. By Alma C. Mitchill. Published by Special Libraries Association, 31 East Tenth St.,

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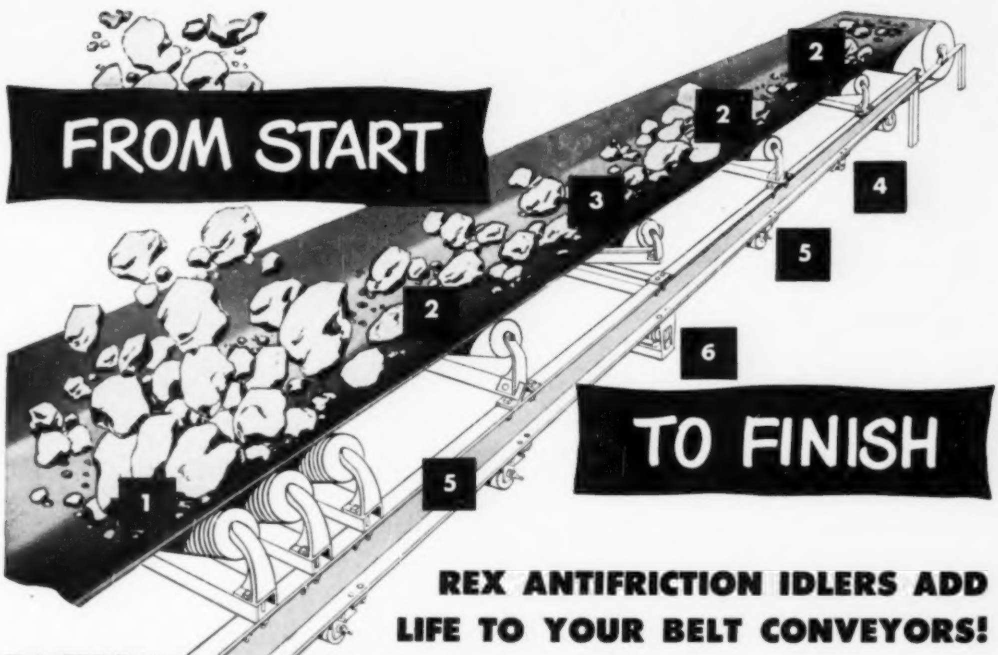
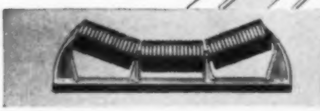
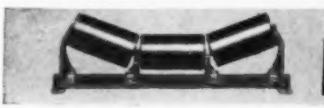


REX ANTIFRICTION IDLERS ADD LIFE TO YOUR BELT CONVEYORS!



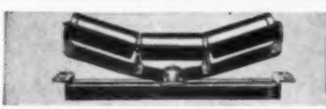
1

REX IMPACT CUSHIONING IDLERS installed under the loading points will take the bumps for your belts . . . minimize ruptures and lacerations. Dual-purpose rubber rolls are scientifically molded with deep primary grooves for maximum cushioning and secondary grooves that provide surface softness to avoid belt laceration.



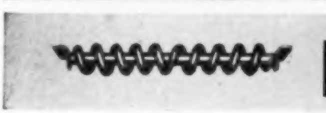
2

REX TROUGHING IDLERS insure minimum service cost and maximum equipment life. Belt friction wear is practically eliminated, and the closely spaced, well-balanced roll units provide an idler assembly that is kind to the belt. There is a type and style for every application.



3

REX SELF-ALIGNING TROUGHING IDLERS automatically align belts without the need for side-guide idlers that impose excessive belt edge wear. They eliminate the misalignments caused by off-center loading, side-wind drifting, warped frames or uneven belt stretch. These idlers fit any belt conveyor frame.

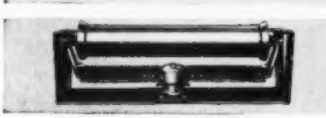


4

REX RUBBER-COVERED SPIRAL RETURN IDLERS create an ever-changing point of contact between belt and idler. Ice, abrasive, corrosive and sticky material cannot build up on the idler and cause premature wear and operating difficulties.

5

REX RETURN IDLERS are dead or live shaft type idlers with hydraulic type fittings for high pressure grease lubrication. They are sturdily built, and their smooth-rolling action cuts belt wear to the minimum.



6

REX SELF-ALIGNING RETURN IDLERS assure automatic belt alignment on the return run. They are similar in general design and effectiveness to the Rex Self-Aligning Troughing Idler.

For complete details on these and the many other idlers in the complete Rex line, write for your copy of Bulletin 463-R. Chain Belt Company, 1648 West Bruce Street, Milwaukee 4, Wisconsin.

CHAIN BELT REX COMPANY

BELT CONVEYOR IDLERS

BOOKSHELF, cont. . .

New York 3, N. Y. 64 pages. $1.75. Guide for operation and management.

Cathodic Protection, A Symposium. Published by the National Association of Corrosion Engineers, 905 Southern Standard Bldg., Houston 2, Tex. 203 pages. $8. Review of the state of development of basic principles of cathodic protection and their application to the control of corrosion.

Iodine Abstracts and Reviews. Published by Iodine Educational Bureau, Inc., 120 Broadway, New York 5, N. Y. 30 pages. Gratis. Vol. 1, No. 1 of a new bi-monthly periodical to provide summaries of scientific and technical literature relating to the uses of iodine and its compounds.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittance should be made by postal money order, coupons, or check. Do not send postage stamps, All publications are in paper cover unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Rayon. "Rayon Prices: Past, Present, and Future." By Robert B. Evans. Bureau of Agricultural and Industrial Chemistry. AIC-235. April 1949. Mimeographed. Elaborate statistical summary of the factors which affect use and cause higher cost and prices, with rather definite forecasts.

Fertilizers. "Influence of Fertilizers on Growth Rates, Fruiting Habits, and Fiber Character of Cotton." By D. R. Hooton, et al. Department of Agriculture, Technical Bulletin No. 979. Price 10 cents.

Termites. "Preventing Damage to Building by Subterranean Termites and Their Control." Department of Agriculture, Farmers' Bulletin No. 1911. Price 15 cents. Drafted largely in popular language for home users but equally adaptable for industrial instruction.

Foreign Production. "Report of the Chemical Products Committee." Interim Report on the European Recovery Programme. Organization for European Economic Co-Operation. Available from Publications Section, Economic Cooperation Administration, Washington, D. C. Includes summary of estimates from co-operating nations regarding nitrogenous fertilizers, rock phosphate, soluble phosphates, potash, sulphur, dyestuffs, and plastic raw materials. Includes forecasts under present programs with estimates for the fiscal year 1952-1953.

Trees. "Trees." Agricultural Yearbook. Price $2. Emphasizes importance of forests to our national and individual prosperity, security, and happiness.

Air Force. "A Guide For Selling to the United States Air Force." Department of the Air Force, 1949. Price 15 cents. An outline of Air Force organization for procurement and identification of regional and general purchasing offices.

Optics. "Research and Development in Applied Optics and Optical Glass at the National Bureau of Standards." By I. C. Gardner and C. H. Hahner. National

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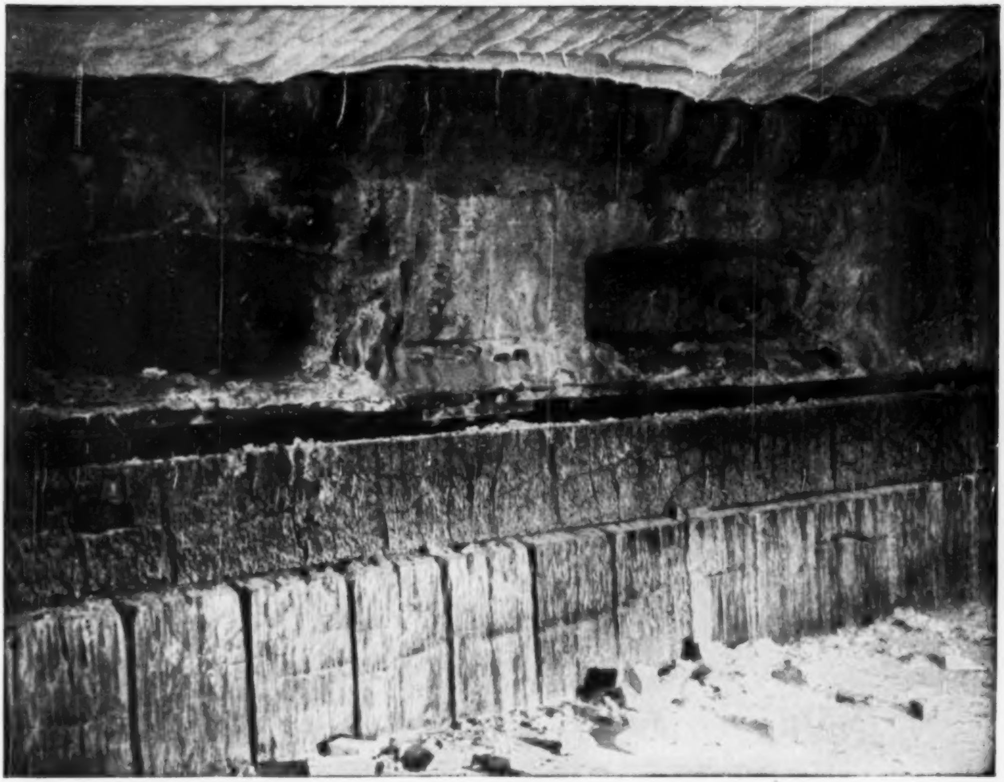

PORTRAIT OF A SUPERSTRUCTURE!

The photograph above shows the first two ports in the melting end of a plate glass furnace after 1290 days and 207,236 tons of glass. (The sidewalls were Corhart Standard blocks — 12″ thick in the lower course, and 8″ thick in the top course.)

But look at that superstructure, built with Corhart Standard Electrocast jambs, plates, crown skew and crown first course. The superstructure took quite a beating in this area, as the 8 remaining inches of the 18″ silica crown plainly shows. Not much is left of the plates, but they did survive the campaign without patching, and the jambs, arches, crown skews and first-course crown blocks are still in excellent shape.

To fortify this area for the next campaign, the operator has installed Corhart Zac refractories in these top course walls and in this entire superstructure area.

If you are not yet making optimum use of Corhart Electrocast products in your superstructure, we would certainly like an opportunity to discuss the potentials with you. . . . Corhart Refractories Co., *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

The words "CORHART," "ELECTROCAST," "ZED," and "ZAC" are Trade Marks which indicate manufacture by Corhart Refractories Company, Incorporated.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

GOVT. PUBS., *cont.* . . .

Bureau of Standards, Miscellaneous Publication 194. Price 15 cents. Principally discusses uses of optical glass. Does not describe large-scale manufacturing equipment which has been elsewhere reported. Includes elaborate bibliography.

Armed Services. "Armed Services Procurement Regulation." Section VII—Contract Clauses and Forms. Price 10 cents. Separate from Armed Services Procurement Regulations. Gives contract clauses and forms available for use in all purchases of the national military establishment. Sales managers of industrial firms selling to any military agency can be guided as to applicable forms of agreement regarding fixed-price contracts.

Bone Char. "Proceedings of the Technical Session on Bone Char, 1949. National Bureau of Standards." Price $2. Available from J. M. Brown, Secretary-Treasurer, Bone Char Research Projects, Inc., c/o Revere Sugar Refinery, 333 Medford Street, Charleston 29, Massachusetts. A resume of extended research conference among supporters of the bureau program.

Research Projects. "Survey of University, Business, and Economic Research Projects, 1947-1948." By Lyle C. Bryant. Small Business Division, Department of Commerce. Price $1. Includes descriptive paragraph about each of nearly 1,200 research projects, a considerable number of which deal with manufacturing and process industry problems. No results are given, merely a description of the scope of surveys or research projects outside government.

Insecticides. "A Photographic Method for Recording Size of Spray Drops." By J. M. Davis. Bureau of Entomology and Plant Quarantine, ET-272.

Wastes. "A Selected Bibliography of Periodical Literature on Fruit and Vegetable Processing Wastes." By O. R. Vasak and W. L. Shaw. Bureau of Agricultural and Industrial Chemistry. AIC-232. Mimeographed.

Business Indexes. "Economic Indicators." A monthly printing of charts and data prepared by the President's Council of Economic Advisors and published by Congressional authority for industrial use. Available by subscription only. Price $1.75 per year. Most of the data report indexes of business activity believed to be most significant in gaging industry trends. General, not specifically related to the industry.

Safety. "Injuries and Accident Causes in Fertilizer Manufacturing. Bureau of Labor Statistics." Bulletin No. 949. Price 20 cents. A detailed analysis of hazards and injury-frequency rates in 1946 by region, plant-size, and department.

Production Survey. "The Concentration of Productive Facilities, 1947." Report of the Federal Trade Commission. Total Manufacturing and 26 Selected Industries. Price 25 cents. Gives for several process industry groups information regarding the large companies and the part which they play in the total national production.

European Economics. "Economic Survey of Europe in 1948." Prepared by Research and Planning division of the Economic Commission for Europe. United Nations Economic and Social Council. Price $1. Gives considerable detail as to European conditions; not up-to-date, but still significant with reference to basic business problems.

Natural Gas. "Natural Gas Investigation (Docket No. G-580)." Federal Power Commission. Report of Commissioners Nelson Lee Smith and Harrington Wimberly. Price $1.50. Report of Commissioners Leland Olds and Claude L. Draper. Price 40 cents. Two documents, summary and opinion of two pairs of commissioners as a result of the protracted natural gas inquiry carried out during a long period ending in 1948. The opinion written by Commissioners Smith and Wimberly includes elaborate statistical summaries, maps, diagrams, and a discussion of products recovered from or made from natural gas as a raw material. The report of Commissioners Olds and Draper gives little new data but presents an entirely different philosophy of federal regulation and recommended national policy.

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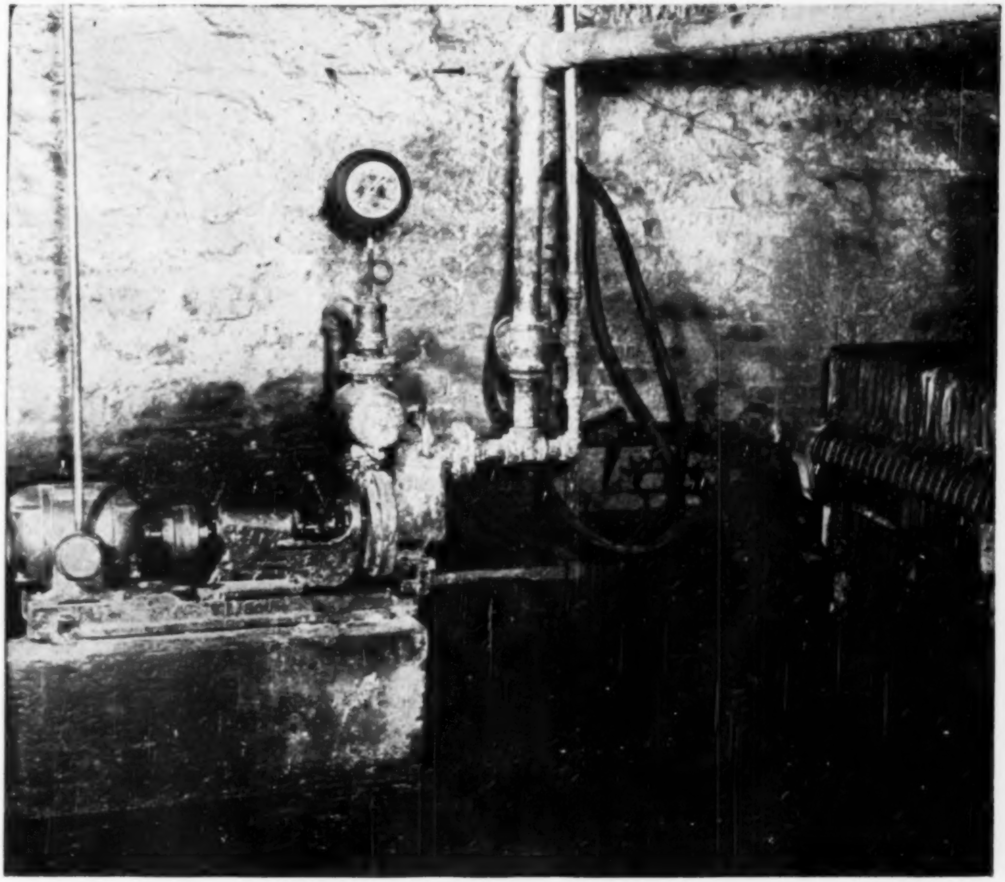

. . . and they specify LABOUR

Pumping color slurry from vats through the filter press, this LaBour pump has exactly the inherent characteristics required to do the job right. It's self-priming, which means it can lift the liquid from a lower level, and will handle air. It's centrifugal, which means it delivers maximum volume at the start of a cycle, and maximum pressure as the filter cake is built up.

This is not a large operation, but it's mighty important to the owner of this pump to be sure of consistent, dependable performance. That, for 27 years now, has been a LaBour specialty in almost every kind of chemical operation in which liquid is moved. It is a fact that one untimely shut down can often cost more in time and material than the pump itself.

Throughout the chemical industry, the men who know how to recognize the needs of a liquid-moving job are quick to understand why they need a LaBour . . . and they specify LaBour.

LaBour
CENTRIFUGAL PUMPS

THE LABOUR COMPANY, Inc. • ELKHART, INDIANA, U.S.A.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Filters. Titeflex, Inc., 523 Frelinghuysen Ave., Newark 5, N. J.—12-page booklet describes filters featuring a backwashing system to aid cleaning. Includes details of construction, drawings illustrating operation, and data on stone membrane and wire mesh membrane.

Resins. Hercules Powder Co., Wilmington, Del.—20-page booklet contains a property chart and description for each synthetic resin made by this company. Includes a full 2-page table showing the degree to which the resins are used in various industries.

Process Equipment. Hardinge Co., 240 Arch St., York, Pa.—32-page Bulletin 16-D deals with rotary dryers, kilns, and coolers. Discusses and fully illustrates the basic principles behind the construction of the various pieces of equipment. Includes over-all dimensions of all models as well as typical flowsheets showing how various rotary units are used in continuous flow operations.

Pumps. Allis-Chalmers Mfg. Co., 1147A South 70th St., Milwaukee, Wis.—24-page Bulletin 08B6146A describes a line of single stage, double suction pumps. Includes tables of available sizes, approximate dimension and head capacities.

Chemicals. Allied Chemical & Dye Corp., General Chemical Division, 40 Rector St., New York 6, N. Y.—175-page book No. 8915 covers industrial chemicals made by this company. For each chemical is given physical properties, grades or strengths available, packing, shipping regulations and principal uses. A brief history of the development of each chemical is given along with photographs showing applications.

Caustic Soda. Allied Chemical & Dye Corp., Solvay Sales Division, 40 Rector St., New York 6, N. Y.—80-page Bulletin No. 6, properties and handling of caustic soda. Fully illustrated.

Wire Cloth. Ludlow-Saylor Wire Co., 632 South Newstead Ave., St. Louis 10, Mo.—31-page booklet—types of wire cloth and screens, production, uses.

Solvents. Allied Chemical & Dye Corp., Barrett Division, 40 Rector St., New York 6, N. Y.—50-page booklet describes with diagrams and pictures the properties and uses of Allied's aromatic industrial solvents.

Metal Mesh. C. O. Jelliff Mfg. Corp., Southport, Conn.—8-page booklet describing a metal screen formed by electrodeposition of pure copper, pure nickel, or a combination of the two metals.

Filters. Elmco Corp., 51-52 South St., New York, N. Y.—8-page Bulletin F-2009 covers the continuous vacuum cane mud filters made by this company. Contains flow charts and diagrams showing the filter in use.

Gage Accessory. Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.—2-page flyer, Unit No. 117, illustrates and

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Mfrs.' Pubs., *cont* . . .

describes the use of an explosion proof gage illuminator.

Baffle. Henry Vogt Machine Co., 1000 West Ormsby St., Louisville 10, Ky.—4-page leaflet describes a baffle for tightly sealing two shell-pass heat exchangers.

Motors. U. S. Electrical Motors Inc., 200 East Slauson Ave., Los Angeles 54, Calif.—8-page Bulletin No. 1524 describes line of horizontal motors, ¼ to 250 hp, and feature asbestos-protected windings.

Process Equipment. Bauer Bros. Co., 1726 Sheridan Ave., Springfield, Ohio.—8-page Bulletin 50 illustrates and describes such equipment as pulp refiners and paper stock classifiers, attrition and hammer mills, magnetic separators, etc.

Filter Cloth. John A. Roebling's Sons Co., Trenton 2, N. J.—4-pages, gives data on resistance to chemical corrosion of filter cloths made of Hastelloy B and C.

Chemicals. Monsanto Chemical Co., Phosphate Division, St. Louis 4, Mo.—Two 8-page booklets describe the properties and function of two complex sodium phosphates. Bulletin No. P-139 covers sodium tripoly phosphate. Bulletin No. P-24 covers tetra sodium pyrophosphate anhydrous.

Equipment. H. W. North Co., 1213 Parade St., Erie, Pa.—Data Sheet No. 300-275 describes the line of mixing and blending equipment.

Agitators. Industrial Process Engineers, 8 Lister Ave., Newark 5, N. J.—4-page Bulletin No. 482 describes construction features, design and applications of this company's line of side-entering agitators.

Gas Absorbers. Patterson Foundry & Machine Co., East Liverpool, Ohio.—9-page paper "Agitated Gas Absorbers" discusses the processes for which gas absorption apparatus of the mechanical agitator type are best suited.

Bark Products. Weyerhaeuser Timber Co., Silvacon Products Dept., Longview, Wash.—4-page Bulletin 10 lists principal uses of fractionated bark products. Contains tables of physical and chemical properties of cork, fibers and powders.

Pumps. Allis-Chalmers Mfg. Co., 1147 South 70th St., Milwaukee, Wis.—16-page Bulletin 08X6256A gives the how and why of centrifugal pump construction and their effect on pump maintenance. Tells how to figure heat; carries tables to help determine total friction loss.

Motors. Telechron Inc., Ashland, Mass.—8-page leaflet gives dimensions, mounting plans and performance ratings for this company's line of synchronous motors. Includes cutaway view showing construction features.

Gear Speed Reducers. D. O. James Gear Mfg. Co., 1140 West Monroe St., Chicago 7, Ill.—82-page price list and selection table of this company's motorized gear speed reducers. There is also a 16-page price list covering gear speed reducers and flexible couplings.

Equipment. Sprout, Waldron & Co., Inc., 17 Sherman St., Muncy, Pa.—12-page Bulletin 44 illustrates and describes equipment for size reduction, mixing and blending, bulk materials handling, product classification, pelleting and special facilities.

Solvents. Celanese Corp. of America, Chemical Division, 180 Madison Ave., New York 16, N. Y.—4-page leaflet listing this company's solvents, their properties and specifications.

Air Filter. Industrol Corp., 88-35 76th Ave., Glendale, Brooklyn 27, N. Y.—1-page flyer lists capacities, dimensions and prices for this company's line of air filters.

Motor Starter. Trumbull Electric Mfg. Co., Plainville, Conn.—4-page Circular TEC-317A describes a manual starter to protect small motors up to 1 hp. from overload. 4-page Circular TEC-151 covers a flexible system for the distribution of light and power.

Silicone Greases. Dow Corning Corp., Midland, Mich.—4-page leaflet No. D-5 describes the properties and performance of

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MFRS.' PUBS., cont . . .

scribes the properties and performance of silicone lubricants. Another 4-page leaflet No. D-6 contains recommendations on the use of silicone grease in the bearings of electric motors.

Materials Handling. Richardson Scale Co., Clifton, N. J.—Bulletin No. 0649 describes an oscillating packer for bagging chemicals, feeds, meals etc. A second bulletin, No. 1349, describes a coal spout for stoker firing. Bulletins 1549 and 1449 describe two types of automatic bulk weighing machines.

Glass Equipment. Corning Glass Works, Corning, N. Y.—8-page Bulletin EB-1 contains photographs and descriptions of plant equipment glassware for the process industries.

Magnetic Equipment. Eriez Mfg. Co., 870 East 12th St., Erie, Pa.—12-page Catalog No. 14 describes a line of permanent non-electric magnetic separators and electronic metal detectors.

Cooling Towers. Marley Co., Fairfax and Marley Rds., Kansas City 15, Kans.—4-page leaflet contains 10 questions and answers on cooling tower specifications.

Blowers. Lamson Corp., Allen Billmyre Division, Syracuse 1, N. Y.—4-page Bulletin B-5-A illustrates and describes the design and operation of the blowers and exhausters made by this company.

Motors. Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.—12-page Book No. 1815A illustrates and describes the gearmotors made by this company. Includes dimensional data and drawings.

Instruments. Builders-Providence, Inc., Providence 1, R. I.—4-page Bulletin 840-F2 describes an instrument to meter chlorine gas and to produce and deliver a chlorine-water solution to the point of application.

Gages. W. C. Dillon & Co., 5410 West Harrison St., Chicago 44, Ill.—4-page leaflet illustrates applications of pressure gage. Includes prices, engineering data and dimensions.

Power Control. Taller and Cooper Inc., 75 Front St., Brooklyn 1, N. Y.—11-page Catalog PL-100 covers special power control equipment such as panel boards, gage boards, switchboards and control consoles.

Alloy Steel. Joseph T. Ryerson & Son, Box 8000-A, Chicago 80, Ill.—24-page booklet contains pointers on the selection of alloy steels.

Safety. Bristol Co., Waterbury 91, Conn.—Bulletin No. W1816 describes a combustion safeguard and explains its application in protecting gas-fired ovens, furnaces, kilns, boilers, etc.

Metal Hose. Atlantic Metal Hose Co., 123 West 64th St., New York 2, N. Y.—Catalog 100 covers recent developments in interlocking and seamless hose as a flexible medium for such applications as diesel exhausts, conveying liquids, gases, solids and semi-solids; and in heat and pressure problems.

Hydraulic Cylinders. Ledeen Mfg. Co., 1600 South San Pedro St., Los Angeles 15, Calif.—2 page Bulletin CS 649 describes the use of hydraulic cylinders for controlling large gate valves in paper mills or chemical plants.

Glass. Corning Glass Works, Corning, N. Y.—14-page Bulletin B-83 entitled "Properties of Selected Commercial Glasses" contains data on properties and major manufacturing methods of glass. 20-page Bulletin B-84 is entitled "Manufacture and Design of Commercial Glassware."

Welding. Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich.—4 page leaflet discusses and illustrates a powder metallizing gun and its use.

Protective Coatings. United Chromium Inc., 51 East 42nd St., New York 17, N. Y.—4-page leaflet gives information on four groups of coatings developed for corrosion control, chemical resistance and heavy duty industrial painting.

Castings. Cooper Alloy Foundry Co., Hillside 5, N. J.—4-page bulletin on corrosion

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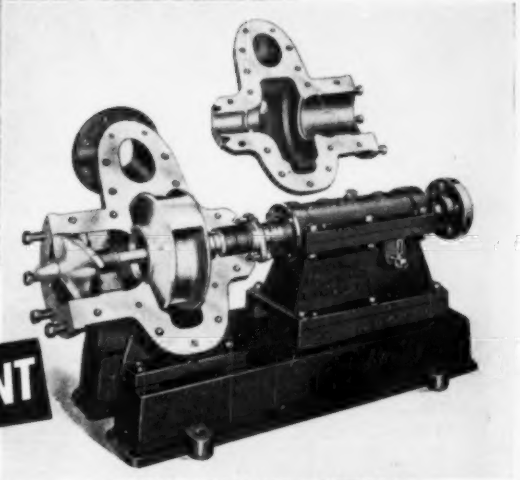
BUILT TO *AVOID* TROUBLE BEFORE IT STARTS!

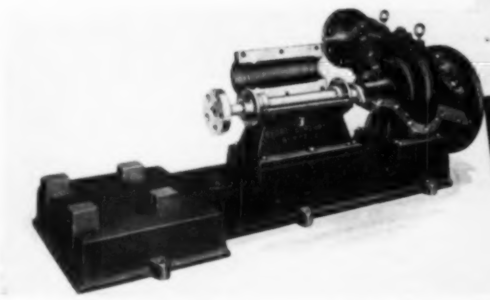
"Buffalo"

DIAGONALLY SPLIT SHELL PUMP

RUGGED

EFFICIENT





EASY TO INSPECT AND SERVICE

HERE'S a thoroughly proven idea in pump design that has reduced maintenance in handling many of industry's most troublesome liquids! Photo at upper right shows how simply the upper casing of this "Buffalo" Pump is removed—without disturbing discharge piping. Above, left, note that bearing inspection is equally quick. Overall construction is oversize to take years of severe service. Too, the exclusive "Buffalo" Non-Clogging Impeller does not depend on close running tolerances for its high efficiencies—which means long-term economy in handling high-consistency liquids. These pumps are available in rubber-lined models for many of your corrosive liquids. *It will pay you to write for Bulletin 982, left,* for the RIGHT "Buffalo" Pump especially made to get YOUR liquid handling costs down!

"Buffalo" PUMPS

BUFFALO PUMPS INC.

501 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Mfrs.' Pubs., cont. . .

resistance of stainless, Monel and nickel castings.

Belting. United States Rubber Co., Rockefeller Center, New York 20, N. Y.—28-page catalog gives design, engineering and performance data for this company's line of transmission belting.

Pumps. F. J. Stokes Machine Co., 5900 Tabor Rd., Philadelphia 20, Pa.—36-page booklet describes a line of high vacuum pumps. Includes specifications and applications.

Adhesives. Paisley Products, Inc., 1770 Canalport Ave., Chicago 16, Ill.—6-page folder discusses and illustrates the uses for adhesive products.

Heavy Chemical Plants. Nicolay Titlestad Corp., 11 West 42nd St., New York 18, N. Y.—Bulletin covers typical heavy chemical plants constructed here and abroad. Contains illustrations and photographs of plants from 10 to 100 tons.

Gas Appliance Accessories. Rockwell Mfg. Co., Pittsburgh Equitable Meter Division, Pittsburgh 8, Pa.—Bulletin 1036 describes a line of gas appliance regulators and allied equipment.

Instruments. Brookfield Engineering Laboratories, Inc., 002 Porter St., Stoughton, Mass.—8-page catalog describes the viscosity measuring device made by this company.

Safety. E. D. Bullard Co., 275 Eighth St., San Francisco 3, Calif.—Catalog covers personal protective equipment and industrial safety devices.

Valve Lubricant. Rockwell Mfg. Co., Nordstrom Valve Division, Pittsburgh 8, Pa.—4-page booklet gives information and data on this company's line of lubricants for automatic plug valves.

Flow Regulators. Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.—6-page Bulletin No. 103 illustrates and describes the line of flow control devices made by this company.

Expansion Joints. Chicago Metal Hose Corp., Maywood, Ill.—26-page catalog contains construction and installation data on corrugated expansion joints.

Process Equipment. Worthington Pump and Machinery Corp., Harrison, N. J.—2-page Bulletin C-1100-S74 gives specifications dimensions, and physical data on ammonia product coolers. 2-page Bulletin C-1100-S73 covers package air conditioners. Bulletin W-395-B1, 4 pages, contains photographs and data on self-priming centrifugal pumps.

Materials Handling Equipment. Hewitt-Robins Inc., Robins Conveyors Division, 270 Passaic Ave., Passaic, N. J.—4-page Bulletin No. 130 describes and illustrates the working of a light-weight car shakeout.

Instruments. Bristol Co., Waterbury, Conn.—32-page Bulletin A120 describes a line of air-operated controllers for temperature, pressure, flow, liquid-level, humidity and pH value.

Cement. Ceilcote Co., Rockefeller Bldg., Cleveland, Ohio—2-page flyer gives the properties and directions for use of a resin cement.

Models. Visual Planning Equipment Co., Pennsylvania Ave. at River, Oakmont, Allegheny County, Pa.—32-page catalog lists models available from this company.

Pumps. De Leval Steam Turbine Co., Trenton 2, N. J.—12-page Catalog 1550 illustrates and describes opposed impeller pumps. Charts show motor and pump sizes. Diagrammatic drawings illustrate dimensions.

Dust Filter. Day Co., 810 Third Ave. Northeast, Minneapolis 13, Minn.—8-page Bulletin 491 illustrates and describes dust filters. Includes schematic drawing showing operating principle and charts giving capacities and dimensions.

Safety. Factory Mutual Engineering Division, 184 High St., Boston 10, Mass.—2-page Bulletin No. 280 discusses fire-safety during plant shut-downs. Lists

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items requiring attention before a plant is closed.

Chemical Cleaners. Sumco Porducts, Inc., 144 Centre St., Brooklyn, N. Y.—Brochure covers chemical cleaning of boilers, feed water heaters, condensers, evaporators, heat exchangers, piping, etc. Describes solvents employed, control methods, and procedures.

Rotameter. Brooks Rotameter Co., P. O. Box No. B-2549, Lansdale, Pa.—4-page Bulletin 6 describes the line of rotameters with safety shielding made by this company.

Instruments. Foxboro Co., Foxboro, Mass. —32-page Bulletin 427 presents a line of instruments for process measurement and control. Explains the principle of operation, gives detail on construction. 16-page Bulletin 430 describes equipment for measurement and control of pH industrial processing operations.

Instruments. Builders-Providence, Inc., Providence 1, R. I.—16-page Bulletin 400-F1 describes flow meters made by this company. Illustrated in detail.

Instruments. Fischer & Porter Co., Hatboro, Pa.—24-page Catalog 50 covers instruments for remote indicating, controlling and totalizing. 4-page Catalog Section 96 deals with a flow rate indicator for coolants, lubricants, opaque liquids and slurries. Catalog Section 97 lists recommended materials of construction for flow rate instruments.

Motors. Howell Electric Motors Co., Howell, Mich.—4-page Bulletin SR-1 illustrates and describes wound rotor machines. Includes performance curve and chart giving dimensions.

Dust Control. American Wheelabrator & Equipment Corp., 555 South Byrkit St., Mishawaka, Ind.—Report on a method of overcoming the dust nuisance created in the handling and mixing of dry pigments used in the manufacture of paint.

Process Equipment. Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.—2-page Bulletin C12-B8 illustrates and describes portable crushing units. Two 4-page bulletins, Nos. G-4907-N and G-4907, catalog various types of equipment this company has in stock for quick delivery.

Gage. Vapor Recovery Systems Co., P. O. Box 231, Compton, Calif.—8-page booklet discusses the construction and use of an electronic liquid level gage.

Cleaners. DuBois Co., Industrial Division, Cincinnati 3, Ohio.—Portfolio on steam cleaning discusses applications and maintenance. Another booklet provides cost figures on emulsion cleaning.

Instruments. Rockwell Mfg. Co., Pittsburgh Equitable Meter Division, Pittsburgh 8, Pa.—Bulletin 1044 describes a line of pressure regulators giving construction and application details. Contains typical performance curves.

Gages. Williams & Hussey Machine Co., Star Brass Mfg. Co. Division, Wilton, N. H.—4-page leaflet describes types, ranges, and construction details of this company's line of gages. Another leaflet describes a gage tester.

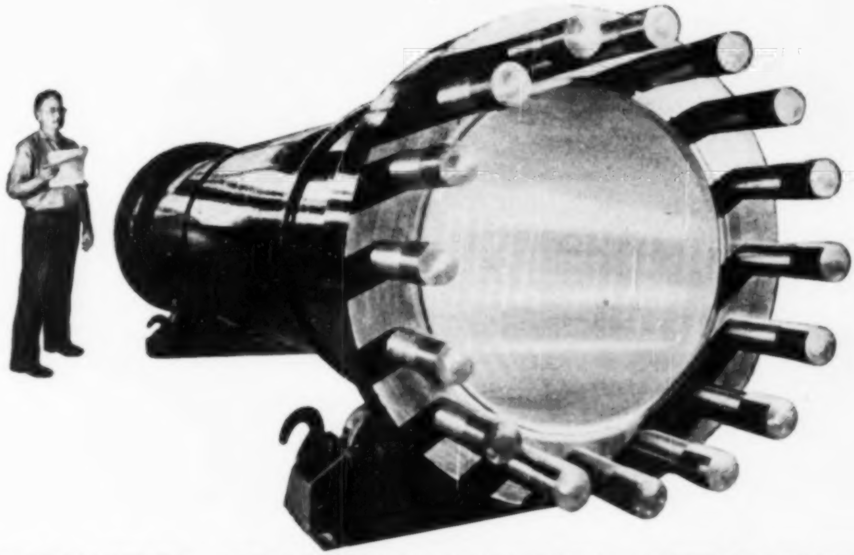
Instruments. Proportioneers, Inc., 9 Codding St., Providence 1, R. I.—8-page File 1709A.21 describes and illustrates the working of this company's instrument for diluting caustic.

Materials Handling. Lewis-Shepard Products Inc., 267 Walnut St., Watertown 72, Mass.—Bulletin 24 covers Jacklift electric trucks for horizontal movement and JackStackers for both horizontal and vertical movement of material on skids and single or double faced pallets.

Gages. Bristol Co., Waterbury 91, Conn. —Bulletin G620 describes a gage for recording and controlling absolute pressure within a scale range as low as zero to 20 mm. Hg abs.

Conveyors. Hapman Conveyors, Inc., 2405-13 West McNichols Rd., Detroit 21, Mich.—40-page Catalog No. 5000 covers pipe conveyors and accessories.

—End



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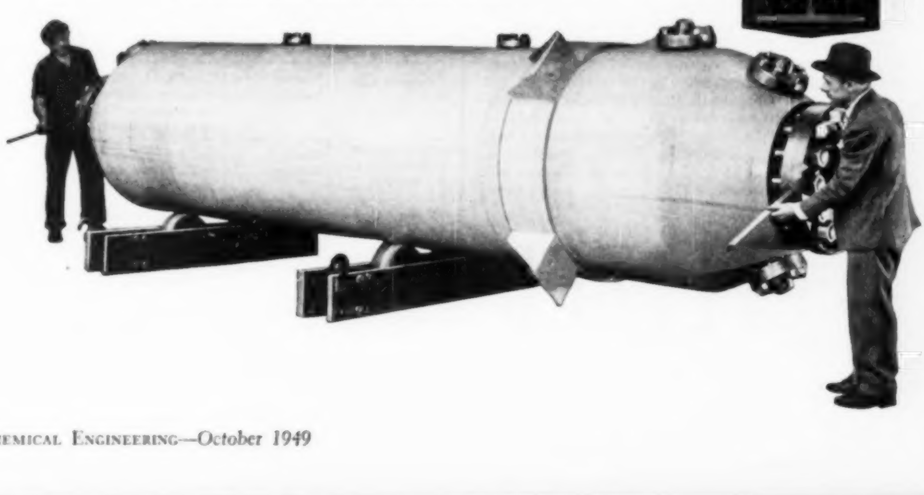

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CITRIC ACID contains a total of four reactive groups. With these readily substituted radicals, just consider the large number of related but chemically different compounds that can be synthesized!

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shown in the table to the right are all produced by Pfizer. The uses listed may suggest other applications worthy of your investigation.

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NEW FIELDS OF USE FOR CITRIC ACID AND ITS DERIVATIVES

	FIELD	USE
Citric Acid	Cleaning and Plating of Metals	Electrolytic polishing of stainless steel.
Ammonium Citrate Dibasic	Cleaning and Plating of Metals	Removes rust and scale.
Sodium Citrate	Water Conditioning	Sequesters metallic contaminants.
Calcium Citrate	Construction	Slows the setting of cement and plaster.
Triethyl Citrate Tributyl Citrate Acetyl Triethyl Citrate Acetyl Tributyl Citrate	Plastics Industry	Plasticizers for a wide variety of synthetic plastics.
Itaconic Acid (Citric Acid less $CO_2 + H_2O$)	Paint and Varnish Industry	Shortens reaction time, gives harder finishes, improves color, shortens baking time of oil modified alkyds.
Itaconic Acid	Plastics Industry	Condensed with glycols or simply esterified, may be polymerized to form clear hard plastics.
Aconitic Acid (Citric Acid less H_2O)	Plastics Industry	For preparation of synthetic resins and plasticizers.
Tributyl Citrate	Textile	Anti-foaming agent.

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Chemical Economics

RICHARD F. WARREN, Assistant Editor

Labor Strife and Possible Declining Export Prices Create Concern in Process Industries

Late in September the great enigma in the chemical consuming industries was the final effect of the devaluation of the pound on world consumption of our chemicals and other products of the process industries. Many trade experts seem to feel that Britain will not cut the export price of any item unless it is in direct competition with a non-sterling product. As a result, process industries were following the general policy of "wait and see." However, most executives seem to feel that there will be no general effect on prices.

Major effect of the current labor strife will be felt in the steel, iron, and related coal chemicals industries. Most consumers have been building up stocks of these products in recent months to prepare for the threatening steel strike.

Late in the summer the consumption of chemicals in the rayon industry picked up as consumption in this branch of the process industries climbed to a new high for the year in August. Deliveries rose to 88 million pounds while rayon stocks dropped 10.5 million pounds in the same month. Exports of rayon will set new records, according to the *Rayon Organon*, if the first half rate continues for the rest of the year. Other fibers heading for new highs in exports include nylon yarn. In the first six months of 1949 more than 1 million pounds were exported. This is still only a small fraction of the total nylon yarn produced. In 1948 an estimated 52 million pounds of nylon were produced. Late in September the iron and steel industry had climbed back to 86 percent of capacity in their operations.

Consumption of chemicals in the petroleum industry was up in August compared with July. However, it is still considerably below the 1948 rate. Researchwise, however, the petroleum industry is investing almost four times as much as it did ten years ago. This is being done to diversify its products. More than $100 million is being spent on research in this industry at the present time according to Dr. Wayne E. Kuhn, manager of Texas Co.'s technical and research division.

Speaking at the ACS meeting in Atlantic City, Linus Pauling, president of the society, urged that both a government sponsored National Science Foundation be established to aid research and that in addition private industry establish a Research Foundation to provide $75 million a year for basic research by 1957. According to government estimates, industrial firms spent $450 million on research in 1947 and by 1957 research expenditures by industry may reach $750 million. Prof. Pauling stated that such expenditures if used to promote work in the private colleges and universities and would "avert the dangers of bureaucratic domination."

A bright future for a strong and vital chemical processing segment of American industry is in prospect if these plans are pushed on to fruition.

With production running 8 percent ahead of 1948, the American potash industry is heading for new output records in 1949. Development of additional New Mexican deposits is being explored by several firms including Duval Texas Sulphur Co.

Regional Distribution of Certain Chemical Process Industries

(Percent of U. S. total)

	Pacific	Mountain	West North Central	West South Central	East North Central	East South Central	Middle Atlantic	South Atlantic	New England
Chemicals & Allied Products									
1947	5.7	0.7	6.1	7.2	25.5	5.4	30.8	14.6	4.0
1939	4.6	0.5	4.9	3.6	26.0	5.6	36.2	13.9	4.7
Petroleum & Coal Products									
1947	10.8	2.5	3.9	28.4	21.5	3.0	25.8	2.4	1.7
1939	12.8	2.7	3.7	23.2	24.2	1.7	27.5	2.3	1.9
Paper & Allied Products									
1947	8.9	....	4.3	3.5	27.0	4.1	25.5	10.9	13.8
1939	8.1	....	3.8	3.8	29.1	2.5	27.7	9.1	15.9
Leather & Leather Products									
1947	1.9	0.3	8.6	0.7	21.5	3.4	30.6	4.8	28.2
1939	1.1	0.2	10.4	0.3	23.5	2.2	28.2	4.3	29.8
Rubber Products									
1947	n.a.	n.a.	2.23	n.a.	44.2	n.a.	16.2	n.a.	16.7
1929	n.a.	n.a.	1.61	n.a.	52.5	n.a.	16.6	n.a.	15.4
Textiles									
1947	0.9	....	0.5	0.8	3.7	6.9	25.6	38.2	23.3
1939	1.2	....	0.8	0.9	4.9	5.5	31.2	29.9	25.5
Glass, Clay & Stone									
1947	7.8	1.4	6.4	4.7	29.8	3.9	29.8	11.4	4.8
1939	6.4	1.3	8.7	4.2	30.0	3.5	26.5	10.5	4.9

n.a.—not available. Source: 1947 Census of Manufacturers—value added to product.

Price Trends

Although there has been some price weakening in limited areas—such as the recent lead pigment cut—the chemical price index shows a definite leveling off in recent months. However, oil and fat prices continued to drop during September. *Chemical Engineering's* oil and fat index fell to 144.67 by October 1.

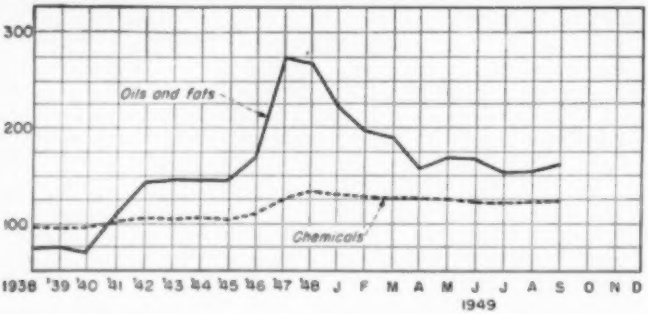
A reversal in buying habits has been taking place in recent weeks. During the summer many chemical firms were operating on a hand-to-mouth to 30-day inventory wherever practical. Now many firms have switched to a 60-day policy. According to the National Association of Purchasing Agents, 98.8 percent of their reporting firms are maintaining a "90 day or less" inventory rule. This policy has been bypassed in the cases where interruption of supplies seems threatened.

A lack of demand has brought a new drop in lead and zinc prices. Among the effects of this dip were cuts in the prices of lead and zinc pigments. Lead acetate fell 2¾c. per lb. and at least one producer cut the white lead price.

Drops in consuming markets have brought on a price adjustment for soda ash by major producers. One producer put out a price schedule eliminating the less than 300 ton carload rate. This made Solvay and others "meet the competition" and their current price in bulk carloads is $1 per 100 lb. for light ash, and $1.10 per 100 lb. for dense ash. Carloads in bags are 25c. per 100 lb. higher.

PRICE, CONSUMPTION AND PRODUCTION TRENDS

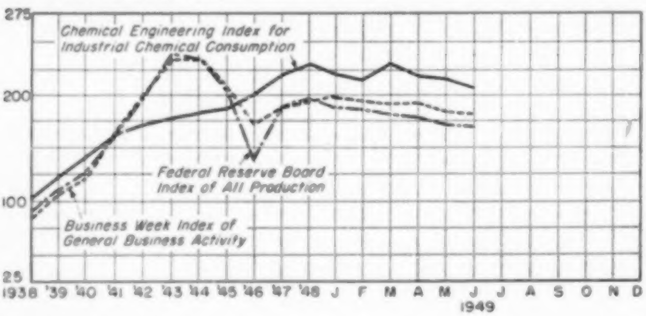
PRICES



Chemical Engineering's Price Index
A month, a year, and two years ago

	Chemicals	Oils & Fats
As of October 1	123.02	144.67
Last month	123.23	161.08
October 1948	132.80	249.27
October 1947	124.94	251.70

CONSUMPTION

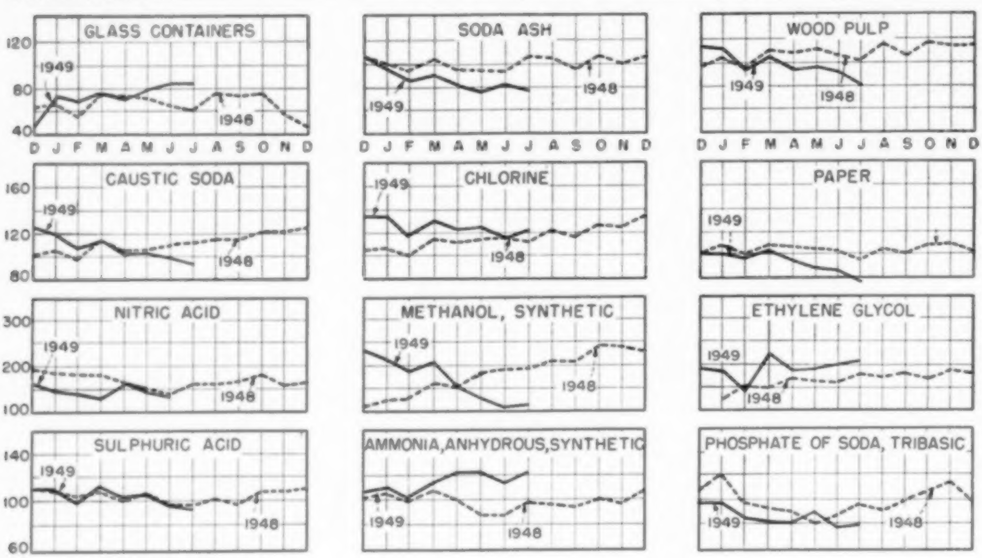


Chemical Engineering's Consumption Index for Industrial Chemicals
(A breakdown by consuming industries)

	June	July
Fertilizers	48.50	49.91
Pulp and paper	20.35	17.80
Petroleum refining	20.18	22.11
Glass	19.15	19.38
Paint and varnish	24.45	20.42
Iron and steel	11.90	10.61
Rayon	19.22	20.02
Textiles	8.41	6.96
Coal products	10.10	9.56
Leather	4.17	3.73
Explosives	7.41	8.19
Rubber	4.86	4.06
Plastics	8.07	7.26
INDEX	206.77	200.01

1935 = 100

PRODUCTION



100=Monthly Average 1947

Commodity Survey:

ETHYL ALCOHOL—II

JOHN R. SKEEN

Industrial alcohol, derived from dozens of raw materials and used almost everywhere, has been a center of conflicting interests throughout its commercial history of less than 50 years. Second only to water in solvent value, ethanol is employed in nearly all industries: drug, food, cosmetic, resin, explosives, polishes, coatings and many others. In addition, it is a starting point for making hundreds of chemicals including acetaldehyde, ethyl acetate, acetic acid, ethylene dibromide, glycols and ethyl chloride. Still a factor as an anti-freeze, alcohol offers some promise of extending its market in the field of motor fuels. This ubiquity probably accounts for the survival of the industry in spite of the keenest and most varied competition, and handicaps imposed by government. These factors continue to operate and have produced a postwar plethora in contrast to the wartime dearth.

John R. Skeen is market research director for Foster D. Snell, Inc.

Slightly less than 200 million gallons were produced during the fiscal year just ended. The installed capacity was nearly double this amount of which synthetic processes accounted for 30 percent, the fermentation of molasses over half, and grain about 14 percent. As the synthetic plants approached maximum operation, they contributed over half that made. This has been the recent trend and necessitated drastic action on the part of the fermenters in order to retain an appreciable share of the market. Publicker Industries provided a solution, however temporary.

Last November molasses sold at 23c. per gal. and so determined the price of alcohol at the 70-80c. level. To effect a reduction without loss it was necessary to obtain the raw material for less. Publicker contracted with the Cuban Government to supply molasses at a price tied to that of the product alcohol. A succession of reductions immediately followed. In May alcohol was offered at 17c. and molasses was obtained for 4c. The Cuban Government canceled the contract. It is generally agreed that profits at that price are not possible although the synthetic industry may be exceptional.

Among the elements contributing to these events are the excess of facilities, the lower cost of ethylene and the government policy of supporting the price of farm crops. In 1940 synthetic capacity was 38 million gallons and that of the industrial fermenters over five times as much. Consumption averaged about half this amount. However, anticipated needs to make synthetic rubber, military explosives, acetaldehyde for rayon and butanol, ethyl chloride and ethylene dibromide for tetraethyl lead, and the expanded demand of the lacquer industry presented a truly critical situation. Estimated requirements varied with time and the agency. Rubber

(Continued)

Industrial Alcohol Supply and Consumption[1]
(Unit million wine gallons of 190 proof)

	Apparent Supply—Total Industrial Alcohol[2]								Industrial Consumption—Denatured Alcohol[3]							
		Production														
		Industrial Plants														
		Synthetic								Chemicals[8]				Solvents[11]		
Fiscal Year	Apparent[4] Supply (net)	Ethyl Sulphate[18]	Total[19]	Other[20]	Distilleries[13]	Stocks[5]	Imports[6]	Anti-freeze[7]	Total[14]	Acetaldehyde[15]	Explosives[9]	Rubber[10]	Total[16]	Proprietary[17]	Other[12]
1935	96.3	9.3	9.3	85.7	....	13.3	0.1	34.0	....	....	....	....	....	....	....
1936	105.2	16.6	16.6	86.6	....	11.2	....	32.1	33.9	11.7	0.2	....	36.2	10.6	2.1
1937	113.3	17.8	17.8	90.1	....	15.0	....	19.5	44.7	19.0	0.2	....	43.2	16.7	1.5
1938	103.6	18.6	18.6	87.2	....	16.8	....	22.6	....	....	....	....	....	....	....
1939	108.1	25.3	25.4	80.4	....	16.3	....	15.1	....	....	....	....	....	....	....
1940	132.5	32.2	32.3	96.0	....	11.5	....	17.4	57.8	24.6	1.0	....	45.2	17.5	1.2
1941	162.9	36.8	37.0	120.3	....	....	0.2	19.0	70.7	30.3	5.6	....	54.2	23.0	1.4
1942	231.1	47.7	46.7	174.8	48.8	41.0	....	32.0	74.8	34.4	26.8	....	50.6	24.5	2.6
1943	298.1	50.9	51.9	183.8	149.8	131.3	6.9	21.8	86.1	44.7	20.3	20.4	43.7	18.4	3.9
1944	503.5	59.9	60.9	274.8	184.2	75.1	17.1	46.0	111.9	50.7	16.7	286.0	40.6	31.7	4.1
1945	609.7	58.8	59.8	299.9	219.9	84.1	40.8	29.1	109.3	55.7	18.1	315.9	40.9	19.6	4.0
1946	299.3	67.1	68.1	118.0	46.8	74.1	24.9	23.0	81.8	54.0	0.9	62.7	50.0	18.4	2.1
1947	205.6	70.2	71.4	59.6	....	14.2	16.8	32.0	93.6	65.6	0.1	9.3	33.1	21.4	2.7
1948	180.8[21]	73.8	74.7	100.2	11	26	17.3	30.7	101.4	72.9	0.1	0.4	46.9	18.3	2.8
1949[22]	192.3	89.0	98.1	86.6	n.a.	26.8	0.2	....	....	....	....	....	....	....	....

[1] Unless otherwise stated, all data from Alcohol Tax Unit: *Statistics on Uses, Statistics on Ethyl Alcohol, The Annual Report of the Commissioner of Internal Revenue.*

[2] While the records in the ATU will permit a balance of the elements of net supply with total withdrawals, "It is impossible to establish a balanced account from only the items published in the *Annual Report*"; this presentation is therefore unofficial and not necessarily accurate; serious inconsistencies arise in 1942 and 1948 and, for the latter year, interpretations of data can be several; for other years, the balance between total withdrawals and supply elements agree within 1 percent, inclusive of losses necessary to omit.

[3] A complete accounting of completely and specially denatured alcohol as consumed; completely denatured alcohol "corrected" to 190 proof, specially denatured is "uncorrected;" tax-paid and other tax-free alcohol not included.

[4] Production in industrial plants or alcohol for industrial use plus change in stocks plus imports less losses; if correct should be equivalent to "total withdrawals."

[5] An inconsistent series; 1935: undenatured alcohol in industrial bonded warehouses; 1941 value for calculating 1940 supply is 10.4 million proof gallon; for subsequent years, stocks at denaturing and other plants and unfinished spirits are also included; the 1941 value for calculating 1942 supply is 37 million proof gallon; the 1948 stocks consistent with 1947 amount to 20.1 million wine gallon, insufficient to account for the 11.0 million wine gallon transferred to industrial bonded warehouses from distillers.

[6] 1935-42: calendar year basis, *U. S. Foreign Commerce and Navigation*; 1943-48: imports released from Custom's custody, see Annual Report, 1948.

[7] 1935-39: only completely denatured alcohol with assumed denaturant volume of 7 percent, corrected to 95 percent equivalent and 95 percent of total assumed to be consumed in anti-freeze in all years; 1940-49: as permitted by code, specially denatured alcohol as reported is included.

[8] Chemical conversion exclusive of synthetic rubber.

[9] Solvent use as reported.

[10] Synthetic, exclusive of accelerators.

[11] All except explosives.

[12] Includes 5 percent of net completely denatured alcohol and minor specially denatured uses-fuel, fluid, laboratory.

[13] 1942-46: includes wineries; 1948: 11.0 million wine gallon transferred from distillers to industrial bonded warehouses and so entered the new supply; 1942-46: "distillers" equals "net production" minus "ethyl."

[14] Includes vinegar and all other chemicals except synthetic rubber.

[15] Also minor amounts of other aldehydes.

[16] Coatings, plastics, resins, cosmetics, processing food, drugs and industrial products, pharmaceuticals, and cleaning, preserving and flavoring preparations.

[17] Brand names and thinners.

[18] Carbide and Carbon Chemicals Corp. and Esso-Standard Oil Co.

[19] Increase over "ethyl sulphate" includes Du Pont, Hercules, Calco, Shell, and Carthage where the first three are minor and byproducts.

[20] Non-synthetic industrial; molasses, grain, potatoes, sulfite, juices, etc.; 1942-46: "ethyl" minus "ethyl sulphate" and "ethylene."

[21] Distillers contributed 11.0 million gallon, to industrial bonded warehouses and the apparent supply may be increased by this amount; as disposition is not revealed, the correction has been applied to "stocks."

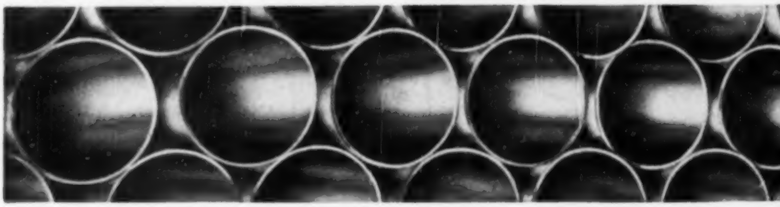
[22] Preliminary.

File Facts

Pilot Plant Results and Operating Data—

CORROSION CONTROL PROJECTS MAKING USE OF THE NEW

Carpenter Stainless Tubing No. 20



This new Stainless is ideal for solving a great many corrosion problems, but is not recommended in some cases. To conduct tests which will be similar to your operating conditions, order test pieces of Carpenter Stainless Tubing No. 20, giving us data on the corrodents, temperatures and processes involved.

These engineering reports on Carpenter Stainless Tubing No. 20—along with bar stock, strip, wire, sheet and plate—show typical results where No. 20 has solved difficult corrosion control problems.

CORRODENT	RESULTS	CORRODENT	RESULTS
Aluminum Sulphate plus Alumina @ 245°F	Excellent, no sign of pitting after 35 working days.	Sulfuric Acid 2/3% @ 68° to 212°F	Carpenter Stainless No. 20 showed no appreciable loss of weight due to corrosion (.00012 IPY).
Concentrated Chlorine Solution	Type 304 pitted. No. 20 satisfactory.	Sulfuric Acid 1/105%	Approx. 8 times as resistant as lead. Expected equipment life 4 years with Stainless No. 20.
Maleic Acid	Excellent (better than Type 316).	Sulfuric Acid 10% @ 140/160°F	Excellent.
Phosphoric Acid	Excellent. Corrosion rate obtained: .0180 IPY.	Zinc Phosphate plus approx. 5% Sodium Chloride @ 180°F	Estimated 10 to 30 times life of Type 302 or 304. Total exposure during test: 460 hours.
Sulfuric Acid 15/50% @ 68°F	Excellent.		

Technical Data Sheets Available

For useful information on the types of jobs that can be handled by No. 20, send a note on your company letterhead and ask for the Carpenter Stainless No. 20 Data Sheets.

THE CARPENTER STEEL COMPANY • ALLOY TUBE DIVISION • 105 Springfield Road, Union, N. J.

Carpenter Stainless No. 20, similar in analysis to Durimet 20, is now available in the forms of Tubing and Pipe, Sheet and Plate, Bar Stock, Wire and Strip.

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STAINLESS TUBING NO. 20

Licensed under patents of The Duriron Co., Inc.

became the determining and uncertain factor. By mid-1942 it was thought that 213 million gallons would be needed annually to make the necessary butadiene and styrene. Within six months this estimate was raised variously to 315 million gallons. Then, too, it could not be said when the highly integrated rubber plants would be synchronized and so a storage problem for alcohol was posed. Only one thing was certain—much more alcohol was needed than the industry could supply.

The first major constructive measure was advocated by the Division of Civilian Supply (later Office) and, during the summer of 1941, the Chemicals Branch initiated a program for production. The conversion of distilleries from beverages to the industrial product followed. Nearly 250 million gallons were expected to be contributed by 135 distillers. Because of the uncertainty of the molasses supply, eastern industrial plants were prepared for the use of grain. This involved a capacity of over 90 million gallons and imposed equipment changes for grain handling, "cooking" and "slop" disposal. The wide use of grain was predicated upon the assumption that the supply of corn was almost inexhaustible. However, the Commodity Credit Corp. soon insisted that wheat be used to the extent of 50 percent and numerous technical difficulties followed.

With all this activity in old centers, agitation developed for establishment of the industry in the West. Early in 1943 grain plants rated at 41 million gallons were authorized to be built at Kansas City, Omaha and Muscadine, Iowa. These began operation in January and later in the next year. Two used potatoes and potato flour. Meantime, 18 million gallons of new synthetic became avail-

(Continued)

Ethyl Alcohol: Approximate Capacity and Price[1]
(Unit: million wine gallons of 190 proof)

		Synthetic Alcohol[3]						Other[2]		
			Carbide and Carbon Ch. Corp.[6]			Esso-Std.[6]				
Fiscal Year	Total[2]	Total[5]	S. Charleston W. Va.	Whiting Ind.	Texas City Tex.[10]	Baton Rouge La.[11]	Other[7]	Industrial Plants[8]	Distilleries[9]	Price[4] c./gal.
1930	...	8.5	8.5	....	....	....	....	.....	...	39.9
1935	...	19.5	8.5	11.0	....	....	....	.....	...	29.9
1936	...	19.5	8.5	11.0	....	....	....	.....	...	29.7
1937	...	19.5	8.5	11.0	....	....	....	.....	...	35.3
1938	...	19.5	8.5	11.0	....	....	....	.....	...	26.3
1939	450	37.6	26.5[15]	11.0	....	....	0.1	.....	...	22.1
1940		37.6	26.5	11.0	....	....	0.1	.....	...	21.6
1941	561	49	26.5	12.5[17]	9.5	....	....	315	227	26.4
1942	616	49	26.5	12.5	9.5	....	....	340[21]	227[24]	40.1
1943			28.7[16]	12.5	18.5[18]	16.0	1.0	.....	...	52.0
1944	730	76.7	28.7	12.5	18.5	16.0	1.0	377[22]	206[22]	50.0
1945	...	76.7	28.7	12.5	18.5	16.0	1.0	.....	...	50.0
1946	...	76.7	28.7	12.5	18.5	16.0	1.0	.....	...	52.5
1947	...	76.9[12]	28.7	12.5	18.5	16.0	1.2	.....	...	74.6
1948	...	79.6	28.7	12.5	18.5	19.0	0.9	.....	...	91.4
1949	787	115.1[13]	28.7	12.5	36	19.0	18.9[19]	405.5[23]	266[23]	51.1[25]
1950	...	>120.1[14]	28.7	12.5	36	19.0	23.9[20]	.....	...	....

[1] Expressed on a fiscal year basis, i.e. a plant of rated capacity which began or could have begun operation before June 30, is included in the year ending on that date; for consistency, price also expressed in fiscal years.

[2] Potential capacity assuming all conversions and operations.

[3] As plant capacities have been estimated or are readily deducible from other published information, the record is presented here.

[4] Fiscal year basis as recapitulated from Bureau of Labor Statistics data; specially denatured, formula no. 1, 190 proof, tanks, fob. East.

[5] Many estimates have been published including 1944: 79.45 million gallons, *Alcohol from Agriculture Commodities*, P. Burke Jacobs, AIC-95, Dept. of Agriculture, 1949: estimates vary from 111 to 130 million gallons; 1950: total may be close to 130 million gallons.

[6] From ethyl sulphate.

[7] Reported as synthetic as required by law; 1939-50: includes by-product alcohol such as from carbon monoxide-hydrogen reactions of Du Pont and recoveries from esters of Calco; Du Pont began 1939 and Calco and Hercules shortly after; Calco unreported in 1947; by-product capacities have been estimated at 2.8 million gallons by Jacobs, *loc. cit.*

[8] Normally producing industrial alcohol as contrasted with beverage alcohol—i.e. tax-free; includes 120-130 million gallons receivable from distilleries for redistillation to 190 proof from 120-160 proof.

[9] Normally producing alcohol directly or indirectly for beverage purposes only—i.e. tax paid; represents capacity to make 190 proof; in addition, 120-130 million gallons capacity for redistillation in industrial plants.

[10] Value for 1949 uncertain; estimates range from 28 million gallons upward; plant began June 1941.

[11] Plant began March 1943, built with D.P.C. funds and operated by Standard Alcohol Co., sub. Standard Oil Co. of N. J.; initial capacity 15-16 million gallons and a capacity of 19 million gallons was attained about 1948.

[12] A significant new supply from petroleum planned and later abandoned.

[13] Includes Shell Chemical Co. at Deer Park, Tex.—18 million gallons, began Oct. 1948.

[14] Union Oil Co. expects to be in production on Pacific Coast starting with ethylene—not included in total; Carthage Hydrocol, Inc., 5 million gallons, is included.

[15] New capacity began June 1939.

[16] New capacity began about July 1943, private funds.

[17] Increase attributed to better operation and more efficient recoveries; not plant expansion.

[18] As originally proposed, new capacity of 9 million gallons to be built with D.P.C. funds; about June 1942, alcohol conversion facilities were cancelled although other necessary equipment was completed.

[19] See ([13]); direct catalytic hydration eliminating ethyl sulphate steps; plant and method said to be "25-30% more economical" than any other.

[20] Carthage Hydrocol, Inc., Brownsville, Tex., plant for making hydrocarbon fuels from natural gas where ethanol becomes a byproduct.

[21] *Smith Hearings*, p. 153, also see p. 810; potential after conversions and additions; new facilities amount to 25 million gallons.

[22] *Alcohol from Industrial Commodities, loc. cit.* exclusive of butyl plants, assumes operation at 330 d./yr., potential capacity from installed facilities.

[23] *Gillette Hearings*, Vol. 1, 1949; "industrial alcohol" includes 127 million gallons obtained from distilleries for redistillation to 190 proof and this amount is included; maximum capacity from installed facilities.

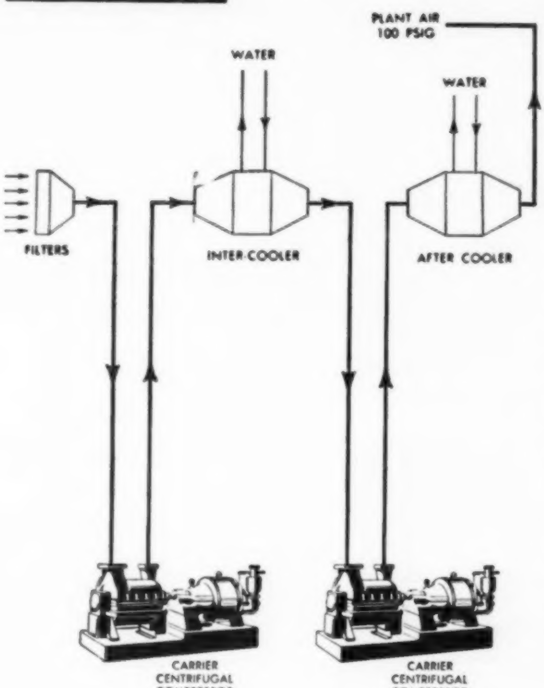
[24] *Smith Hearings*, 1942, p. 186, see also p. 567—262 million gallons; potential capacity after new facilities and conversions.

[25] Eleven-month average: July-May.

PROBLEM:

How to get large volumes of plant air

SOLUTION:



This diagram shows how Carrier Centrifugal Compressors in series easily compress air up to 100 PSIG or even higher. Like other rotating machinery (steam turbines, centrifugal pumps), they do the large jobs better at less cost than by any other means.

Carrier Centrifugals compress air without pulsation—a result important to flow measurement or catalyst beds. Process air is not contaminated by compressor lubricating oil. Efficiency is high for partial loads and is sustained for the life of the equipment. Ruggedly built to Carrier's exacting standards, these compressors operate for years free of the maintenance problems on valves, pistons, etc., that arise with reciprocating equipment. Space requirements are low.

Standard Carrier Centrifugal Compressors with intake volumes between 7000 and 30,000 cfm at discharge pressures of 100 PSIG are available for this application. They are adaptable to direct turbine or motor drives, and can readily be fitted into the plant heat balance.

Carrier is qualified through years of research and experience to help with problems involving large volumes of air and gases. And a staff of Carrier-trained engineers is readily available for consultation. Carrier Corporation, Syracuse, New York.

Carrier CENTRIFUGAL COMPRESSORS • REFRIGERATION EQUIPMENT

able. In addition, a 2 million gallon sulphite plant was erected at Bellingham, Wash., and a wood hydrolysis project at Springfield, Ore., capable of making 4 million more. The net result was that the industry added nearly 80 million gallons to the capacity existent in 1941. The problem became one of how to use it.

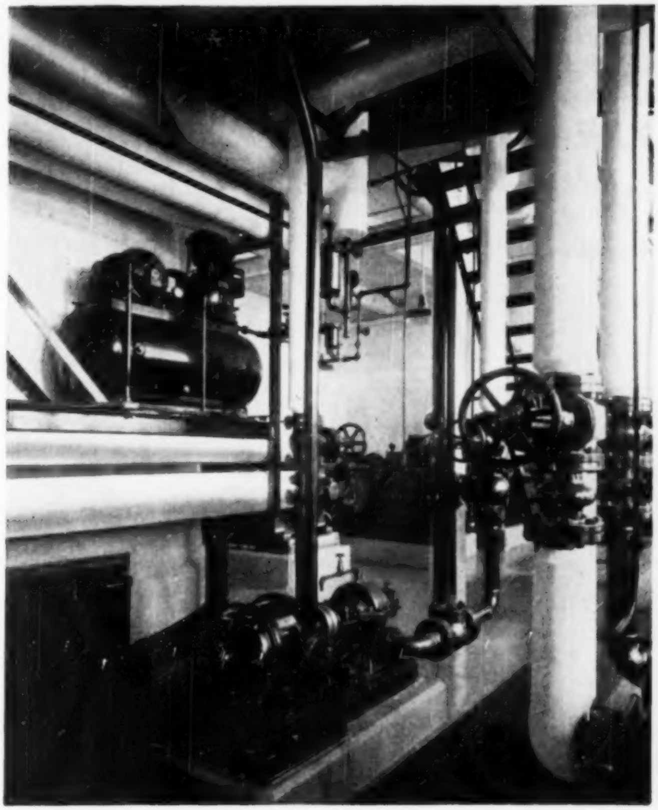
With the end of hostilities, distilleries and wineries reverted to beverage production, natural rubber returned and the synthetic rubber schedule was reduced. As butadiene from petroleum sources was far less expensive than from ethanol, the alcohol-butadien plants were discontinued. Thus another major market was lost to petroleum chemistry. Of the 350-360 gal. capacity operated by industrial alcohol producers at the end of the war, hardly more than 200 were regarded by many as being "reasonably economic." The price of grains was prohibitive. One authority is of the opinion that potatoes are an unprofitable source at any price, i.e. free. The record of sulphite and wood waste operations appears to be unpromising except under unusual conditions. Two years ago, synthetic processes dominated the supply with molasses a poor second. Only molasses offered opportunity for reducing costs of fermentable materials.

With the rise of the chemical industry, England made available a denatured, tax-free alcohol nearly a century ago. Germany followed. It was not until 1906 that industrial value was recognized domestically when the tax-free bill was passed by Congress. The industry may be said to date from then and as a byproduct of beverage production.

The first World War created a demand for the manufacture of smokeless powder, mustard gas, airplane dope, TNT and other chemicals. Production of denatured alcohol increased from 10 to 50 million gallons within five years. This meant the creation of a separate industry operating from molasses imported to Philadelphia, Baltimore and New Orleans. In addition, four wood fermentation plants were erected and operated in Illinois, Mississippi, South Carolina and Louisiana. Three others produced from sulphite pulp in New York, Wisconsin and Pennsylvania. The sharp drop in price which followed peace saw the discontinuance of all except the new molasses plants. These dominated the domestic supply until recent years. The installation of the U. S. Industrial Alcohol Co. at Curtis Bay was the world's largest unit.

This company also pioneered the use of alcohol as a motor fuel in 1918. For two years a 10-90 blend of anhydrous alcohol and gasoline was offered under the name of Alcogas. The market was unreceptive. However, the automobile created a major new outlet in anti-freeze and alcohol was supplied. New uses multiplied. In 1924, alcohol was first used commercially to make ethyl chloride, tetraethyl lead and ethyl cellulose.

In these years the young industry was subjected to the added rules and penalties attendant to the effort to enforce Prohibition. The use of the new and partially competitive solvents—butanol, isopropanol and glycol—was encouraged. In spite of this, the the Carbide and Carbon Chemicals Corp. obtained a 30-day test permit from the Prohibition Commissioner in May 1929 in order to make synthetic alcohol. Commercial production began the next year. Today, Carbide is the largest domestic maker. Of the fermentation group, the dominant suppliers are Publicker, U. S. Industrial Chemicals, E. I. du Pont de Nemours & Co. and Commercial Solvents Corp. As a result of recent events, many are of the opinion that the synthetic product will capture most of the market. Already great strides have been made. —*End*



United States Production of Certain Chemicals

Chemical (Tons unless otherwise noted)	June 1949	June 1948	May 1949	May 1948
Ammonia, synthetic, anhydrous[1]	103,217	81,844	110,129	82,408
Ammonium nitrate	88,886	70,390	93,366	76,000
Ammonium sulphate, synthetic (M lb.)	40,158	29,134	43,098	29,632
Calcium arsenate (M lb.)	1,790	5,498	1,515	3,399
Calcium carbide, commercial	47,424	54,585	45,804	59,000
Carbon dioxide:				
Liquid and gas (M lb.)	34,771	21,388	22,184	29,900
Solid (M lb.)	91,987	82,462	81,481	75,317
Chlorine	134,572	133,231	143,718	130,928
Chrome green (M lb.)	761	456	486	1,097
Chrome yellow and orange, (C.P.) (M lb.)	2,455	4,306	2,004	3,871
Hydrochloric acid	34,833	34,930	37,825	38,349
Hydrogen (M cu. ft.)	2,033	2,207	2,181	2,304
Lead arsenate, acid and basic (M lb.)	794	2,007	711	3,127
Molybdate chrome orange, (C.P.) (M lb.)	278	500	347	577
Nitric acid	97,476	81,888	99,800	86,487
Oxygen (M cu. ft.)	1,048	1,298	1,286	1,370
Phosphoric acid (50 percent H_3PO_4)	97,644	95,396	111,040	98,565
Soda ash:				
Ammonia-soda process:				
Total wet and dry[2]	309,370	347,656	295,741	360,110
Finished light[3]	152,667	178,962	139,208	174,450
Finished dense	114,015	111,130	103,144	125,350
Natural[4]	17,820	26,837	17,565	25,418
Sodium bicarbonate, refined	11,341	11,988	11,808	13,387
Sodium bichromate and chromate	4,648	7,916	5,296	7,962
Sodium hydroxide:				
Electrolytic process:				
Liquid[5]	126,568	130,496	134,523	126,100
Solid	18,934	23,097	19,835	23,383
Lime-soda process:				
Liquid[5]	43,715	60,090	42,189	60,165
Solid	11,499	18,177	12,496	19,109
Sodium phosphate:				
Monobasic	1,017	886	811	1,080
Dibasic	8,966	6,457	9,180	5,756
Tribasic	5,016	6,032	6,236	5,504
Meta	1,907	2,716	2,019	2,837
Tetra	5,457	4,919	5,596	5,205
Sodium silicate, anhydrous	37,658	39,063	43,277	33,588
Sodium sulphate:				
Anhydrous	8,097	13,263	10,863	12,876
Glauber's salt[4]	9,411	15,029	11,277	15,828
Salt cake[4]	39,976	50,573	43,208	57,682
Sulphuric acid[6, 7]				
Chamber process	201,248	219,538	222,435	262,200
Contact process, new	597,283	567,262	654,492	613,646

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finish light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid materials, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Synthetic Organic Chemicals

Chemical	June 1949	June 1948	May 1949	May 1948
Acetanilid	560,693	142,166	521,107	170,791
Acetic acid:				
Synthetic[1]	23,994,732	35,739,677	27,987,015	37,144,452
Recovered	81,645,202	131,203,932	93,737,024	141,818,853
Natural[2]	1,525,151	2,301,028	1,634,121	1,946,262
Acetic anhydride[3]	35,333,554	57,783,922	39,774,520	64,640,881
Acetone	32,600,528	41,097,468	33,410,177	42,127,687
Acetylsalicylic acid	1,008,758	648,656	939,913	559,376
Aniline	5,265,368	7,166,226	5,529,300	7,938,405

(Continued on page 322)

U. S. Production of Synthetic Organic Chemicals, cont. from page 320

Chemical	June 1949	June 1948	May 1949	May 1948
Barbituric acid derivatives:[5]				
5-Ethyl-5-Phenylbarbituric acid and salts (phenobarbital)	20,838	15,553	22,900	18,437
Benzene:				
Motor grade:				
Coke oven operators[6]	2,633,207	757,513	2,613,302	919,070
All other grades:				
Tar distillers[4]	619,304	1,030,773	928,150	1,123,305
Coke oven operators[6]	9,788,060	11,864,960	11,220,088	12,161,976
Butyl alcohol, primary, normal	8,496,678	8,337,429	9,846,981	10,103,815
Carbon bisulphide	27,591,173	32,791,873	26,237,968	37,533,338
Carbon tetrachloride	13,673,903	15,971,606	13,637,213	17,251,426
Chlorobenzene, mono	12,999,617	23,663,614	17,162,032	24,226,129
Creosote oil:				
Tar distillers[4]	11,057,907	7,666,515	11,478,268	8,644,171
Coke oven operators[6]	2,164,523	2,987,068	2,249,991	2,946,314
Cresols, meta-para	331,414	735,469	235,268	6,663,632
Cresols, ortho-meta-para		812,757	500,916	908,665
Cresylic acid, refined[7, 10]	1,927,932	2,742,977	1,749,079	2,715,342
Dibutyl phthalate	1,312,347	615,503	....	1,428,480
Dichlorodiphenyltrichloroethane (DDT)	3,125,185	355,262	2,999,012	562,648
Ethyl acetate (85 percent)	5,479,318	5,762,529	5,368,293	5,787,618
Ethylene glycol	37,615,089	30,741,787	36,679,833	32,144,429
Ethyl ether	3,036,203	2,979,121	2,346,172	3,218,547
Formaldehyde, 37 percent by wt	43,262,795	45,658,213	38,519,779	55,030,129
Hexachlorocyclohexane	1,219,482	936,083	808,328	1,760,203
Methanol, natural	970,303	1,335,078		1,348,923
Methanol, synthetic	46,635,525	85,519,953	58,857,386	84,833,442
Naphthalene:				
Tar distillers, less than 79° C	8,408,052	16,997,455	8,239,373	17,827,164
Tar distillers, 79° C. and over	5,138,878	8,421,981	4,972,831	7,966,181
Coke-oven operators, less than 79° C	5,217,671	7,888,406	6,843,065	8,042,261
Penicillin and salts[8]	10,071,928	8,080,588	11,845,327	8,505,435
Phenol	14,152,514	22,936,803	16,965,968	21,708,337
Phthalic anhydride	8,017,853	11,606,215	9,537,421	13,631,777
Styrene, government and private plant	28,286,193	31,035,013	32,089,036	35,591,409
Toluene:				
Coke-oven operators	2,226,391	2,453,296	2,497,671	2,355,183
All other[9]	3,306,925	3,932,823	4,815,042	4,082,063
Xylene, crude	5,364,446	6,147,291	4,924,885	5,632,101

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

NEW CONSTRUCTION

	Current Projects		Cumulative 1949	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$68,000	$200,000	$342,000	$1,460,000
Middle Atlantic	150,000	387,000	158,633,000	15,532,000
South	300,000	68,000	9,319,000	31,313,000
Middle West	100,000	780,000	13,254,000	32,870,000
West of Mississippi	1,075,000	22,001,000	46,668,000	93,538,000
Far West	1,570,000	140,000	7,495,000	61,861,000
Canada	20,168,000	223,000	51,333,000	60,903,000
Total	$23,431,000	$23,799,000	$287,044,000	$297,477,000

Proposed Work

Calif., San Francisco—General Petroleum Corp., 417 Montgomery St., plans to reconstruct its Islais Creek plant. Estimated cost will exceed $70,000.

Conn., Hartford—Standard Paper Co., 302 Market St., plans to construct a warehouse. Robert W. Loomis, 32 Maple Ave., Windsor, Conn., Struc. Engr. Estimated cost $68,000.

Neb., Morrill—Chemical Corps, Inc., Scottsbluff, plans the construction of a processing plant here. Estimated cost $75,000.

N. J., Vineland—Kimbel Glass Div. of Owens-Illinois Glass Co., 405 Madison Ave., Toledo, O., plans the construction of Warehouse No. 32. W. W. Weullner, c/o owner, Archt. Estimated cost $150,000.

O., Cleveland—Standard Oil Co. of Ohio, 2735 Broadway Ave., plans to construct small naptha tanks at its refinery here. Estimated cost $100,000.

Tenn., Chattanooga—Tennessee Products & Chemical Corp., Alton Park, plans to rebuild its chemical plant. Estimated cost will exceed $300,000.

Tex., Chesterville—Del Ray Petroleum Co., N. Esperson Bldg., Houston, plans to construct a gasoline refinery here. Estimated cost $1,000,000.

Utah, Marysvale—Green River Exploration Co., Salt Lake City, plans to construct a uranium ore mill near here. Estimated cost $500,000.

Wash., Seattle—Standard Oil Co. of California, 225 Bush St., San Francisco, Calif., plans to construct new petroleum accessories and repair warehouse, also 22 storage tanks with a capacity of 154,000 bbls., pier, garage, boiler and pump houses, loading rack and bulkhead. Estimated cost $1,000,000.

Ont., Sarnia—Sun Oil, Ltd., 29 Basin St., Toronto, Ont., has leased a 150 acre site here and plans to construct an oil refinery. Estimated cost $20,000,000.

Que., Lachine—Vi-Lut Candle Mfg. Co., Ltd., St. Joseph St., plans to construct a candle manufacturing plant. Estimated cost $100,000.

Que., Thetford Mines—Johnstone Asbestos, Ltd., Thetford Mines, plans to construct a 1 story, 40x300 ft. warehouse. Estimated cost $68,000.

Contracts Awarded

Ala., Sheffield—Electro Metallurgical Co., Niagara Falls, N. Y., has awarded the contract for an addition to its plant to C. G. Kershaw Contracting Co., 2212 20th Ave., S., Birmingham. Estimated cost will exceed $68,000.

Ark., North Little Rock—Visking Corp., 1200 East 8th St., manufacturer of cellulose sausage casings and other cellulose and plastic products, has awarded the contract for an addition to its plant to Ditmars, Dickman & Pickens, Gazette Bldg. Estimated cost $1,000,000.

Calif., Newark—Westvaco Chemical Div., Food Machinery & Chemical Corp., Newark, has awarded the contract for a manufacturing plant to United Engineers & Constructors, Inc., Box 1189, Newark. Estimated cost will exceed $70,000.

Calif., South San Francisco—E. I. du Pont de Nemours & Co., Inc., Linden Ave., and Wilmington, Del., has awarded the contract for warehouse alterations to Cahill Bros., 206 Sansome St., San Francisco. Estimated cost $70,000.

Conn., West Hartford—Pittsburgh Plate Glass Co., 40 Chapel St., Hartford, has awarded the contract for a 1 story, 100x330 ft. warehouse and office building to wadhams & May Co., 15 Lewis St., Hartford, at $199,850.

Del., North Claymont—General Chemical Co., 40 Rector St., New York, N. Y., has awarded the contract for an addition to its manufacturing plant here to Thomas Earle & Sons, Land Title Bldg., Philadelphia. Estimated cost will exceed $68,000.

Ill., Chicago—Chicago Carton Co., 4200 South Pulaski St., manufacturer of paper boxes, has awarded the contract for an addition to its plant to contain 100,000 sq. ft. floor space to Carl E. Erickson, 4657 North Ravenswood St. Estimated cost $700,000.

Ill., Chicago—City Glass Co., 3018 Wabash St., Chicago, has awarded the contract for a glass processing plant to Rogin Construction Co., 1009 North Wells St., Chicago. Estimated cost $80,000.

Md., Baltimore—F. S. Royster Guano Co., Royster Bldg., Norfolk, Va., has awarded the contract for a fertilizer building at 2001 Chesapeake Ave., Fairfield to D. J. Rose & Son, Rocky Mount, N. C. Estimated cost $100,000.

Md., Baltimore—Procter & Gamble Co., Gwynne Bldg., Cincinnati, O., has awarded the contract for the construction of a light manufacturing building at Locust Point to H. K. Ferguson Co., 1783 East 11th St., Cleveland, O., at $69,495.

Mo., St. Louis—Mallinckrodt Chemical Works, 3600 North 2nd St., has awarded the contract for a 1 story, 83x123 ft. water house for chemical plant at 64 Destrehan St., to Dickie Construction Co., 520 Louderman Bldg. Estimated cost $70,000.

Pa., Philadelphia—Globe Solvents Co., 7th and Fishers Ave., has awarded the contract for the construction of a factory to Keystone Construction Co., 1239 Unruh St. Estimated cost $150,000.

Tex., Abilene—Patton Oil Refinery, Abilene, has awarded the contract for reconstructing its refinery to J. McWilliams & Co., Sweetwater. Estimated cost $92,000.

Tex., Gainesville—Southland Naval Stores Plant, Gainesville, manufacturer of paint thinners, will reconstruct its plant here. Work will be done by owners. Estimated cost $75,000.

Tex., Galveston—Stanolind Oil & Gas Co., Gulf Bldg., Houston, will construct a warehouse. Work will be done by owners. Estimated cost $75,000.

Tex., Houston—Lone Star Cement Co., 402 Concrete St., has awarded the contract for an addition to its plant to Peterson Bros., 2301 North Wayside Dr. Estimated cost $70,000.

Tex., Kenedy—Archer-Daniels Midland Co., Kenedy, has awarded the contract for the construction of a linseed oil refinery to S. E. Newman, Kenedy. Estimated cost $75,000.

Tex., Midland—Pittsburgh Plate Glass Co., c/o T. Jackson, Dallas, has awarded the contract for a plant and shop to T. C. Bateson Construction Co., 622 Irwin Keasler Bldg., Dallas, at $118,600.

Tex., Port Mansfield—Pure Oil Co., Beaumont, will construct a warehouse here. Work will be done by owners. Estimated cost $100,000.

Tex., Sherman—Lone Star Gas Co., 1915 Wood St., Dallas, will remodel its warehouse. Work will be done with own forces. Estimated cost $75,000.

Tex., Victoria—E. I. du Pont de Nemours & Co., Inc., LaPorte, Tex., and Wilmington, Del., will construct 9 plant buildings for the manufacture of nylon chemicals on a 170 acre site on the Guadalupe River, also four service buildings. Work will be done by purchase and hire under supervision of T. F. Pierce, field project manager. Estimated cost $16,500,000 and $2,750,000 respectively.

Utah, Salt Lake City—Salt Lake Refining Co., North Salt Lake City, has awarded the contract for a catalytice cracking plant to Bechtel Corp. of California, 222 Bush St., San Francisco, Calif. This is part of $10,000,000 expansion program planned by company.

Alta., Hanna—Chloro Gas Products, Inc., Long Beach, Calif., has awarded the contract for the construction of a plant to Hanna Petroleum, Ltd., Hanna. Estimated cost $150,000.

Ont., Sarnia—Imperial Oil, Ltd., 445 North Christina St., has awarded the contract for a 2 story addition to its grease plant to Sarnia Bridge Co., Ltd., 251 Campbell St. Estimated cost $73,000.

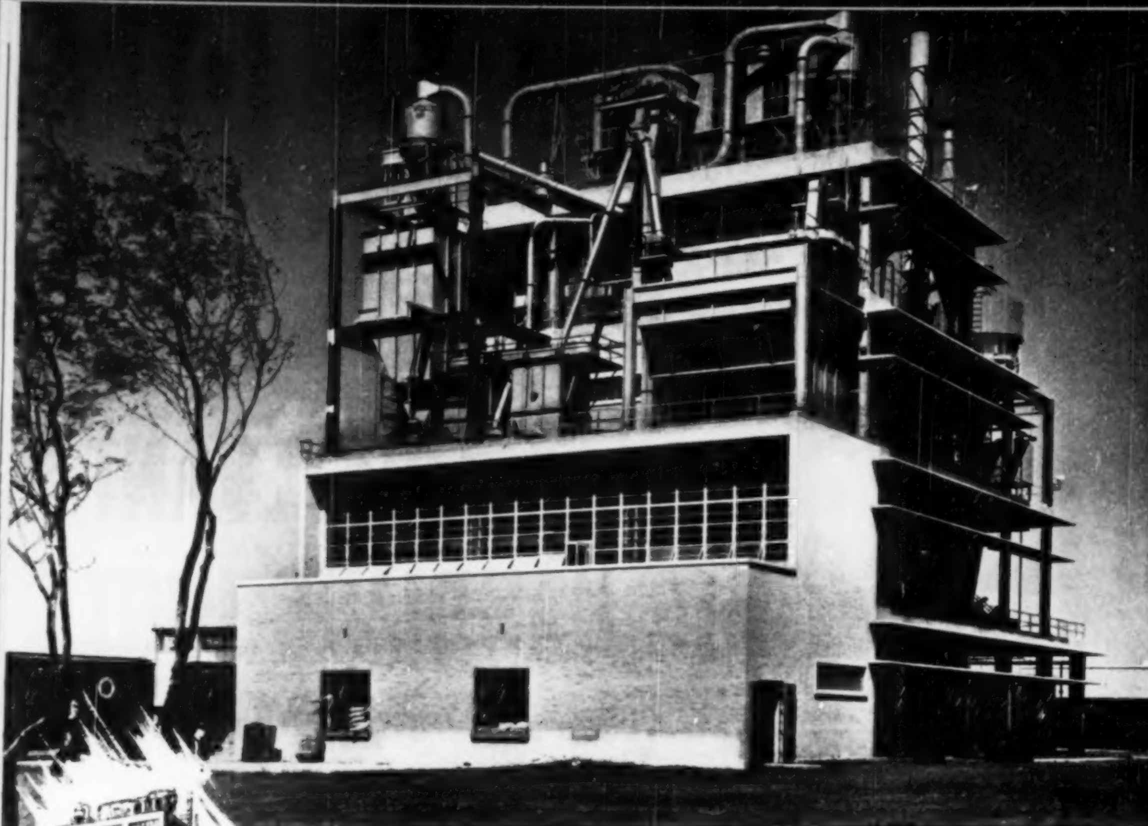


Photo by Elwood Payne

GONE WITH THE WIND... *the drag on Profits*

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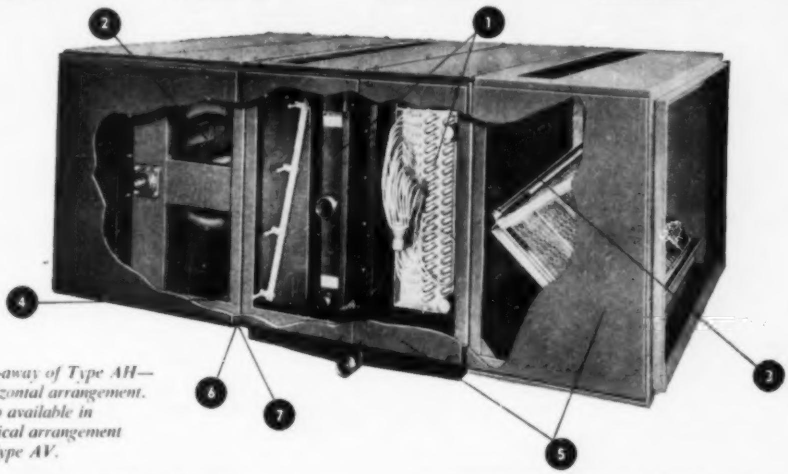


Cut-away of Type AH—horizontal arrangement. Also available in vertical arrangement—Type AV.

1. ALL TYPES OF COILS AVAILABLE
—for well water, chilled water or Freon, as well as hot water or steam—a complete line.

2. STABLE, QUIET FAN OPERATION
—with a revolutionary fan design. Non-overloading horsepower, steep stable pressure characteristic, certified performance.

3. MINIMUM INTERNAL RESISTANCE
—static pressure requirements kept low. Ample filter area, plate-type fins, eddy-free flow.

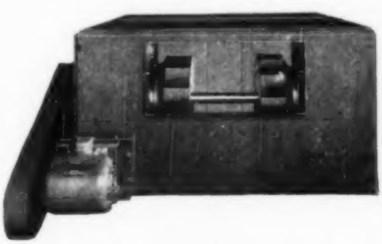
4. RUGGED, INSULATED CABINET
Sectionalized casing with welded, gussetted structural angle frames and insulated panels.

5. EXCELLENT MAINTENANCE ACCESSIBILITY
—wide, gasketed, hinged doors for easy filter removal. Fan and coil section panels removable.

6. FLEXIBLE DESIGN
—sectional construction permits wide variety of assembly arrangements and uses.

7. EASY TO ASSEMBLE AND INSTALL
—shipped in sections for ease of handling. Single outlet simplifies duct work.

8. UNDIVIDED RESPONSIBILITY
—fans, coils, motor . . . every *major part a product of* one *manufacturer. You can't get this vital, plus-value anywhere else!*



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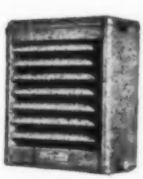

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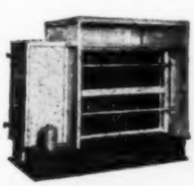

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"Don't send a boy to

There's a Powell Valve* that's just *right* for every known FLOW CONTROL SERVICE

Fig. 560—200-pound Bronze Regrinding Horizontal Swing Check Valve with screwed ends, screwed-on cap and regrindable, renewable bronze disc.

Fig. 150 — 150-pound Bronze Globe Valve with screwed ends, union bonnet and renewable composition disc.

Fig. 1837 — 200-pound Nickel Globe Valve with screwed ends, union bonnet and inside screw stem. Made with bolted bonnet in sizes 2½" and 3".

Fig. 1828 — 200-pound Monel Metal Gate Valve with screwed ends, screwed-in bonnet and inside screw rising stem.

POWELL

do a man's work" . . .

Most valve failures are the result of misapplication . . . installing valves that aren't of the right design or sturdy enough to do the job for which they are selected. In other words, it's like "sending a boy to do a man's work."

On the other hand, it's a waste of money to specify costly valves for services where less expensive ones may be used. This amounts to putting a man on a job that a boy can do.

To avoid misapplication: (1) standardize on Powell Valves; (2) consult Powell Engineers as to which valves are specifically adapted to each and everyone of your individual flow control requirements.

Powell makes such a *complete* Line* that there is a Powell Valve *exactly* suited to every existing service, from the simplest to the most specialized or exacting. Ask your nearest Distributor—or write direct.

Fig. 500 — 125-pound Bronze Gate Valve with screwed ends, screwed-in bonnet, inside screw rising stem and tapered wedge; solid in sizes ¼" to ¾"; double in sizes 1" to 3".

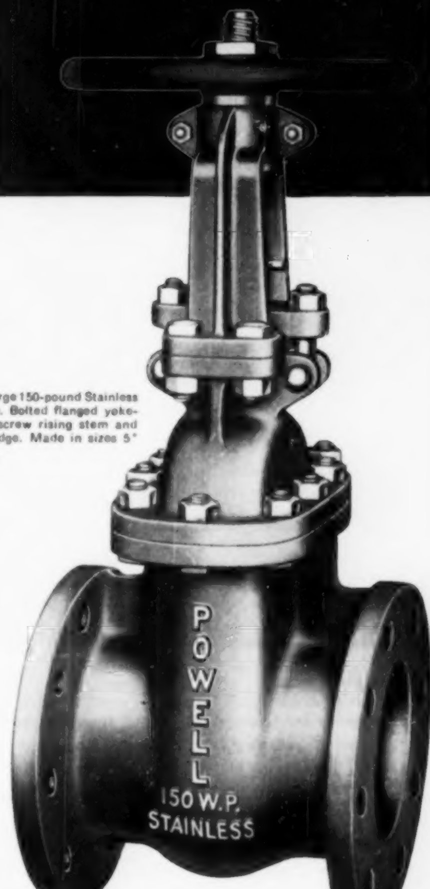

Fig. 2453-G—Large 150-pound Stainless Steel Gate Valve. Bolted flanged yoke-bonnet, outside screw rising stem and tapered solid wedge. Made in sizes 5" to 30", inclusive.

SEE OUR EXHIBIT
BOOTH 54
22nd Exposition of Chemical Industries
Grand Central Palace, New York City
Nov. 28 to Dec. 3, 1949

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

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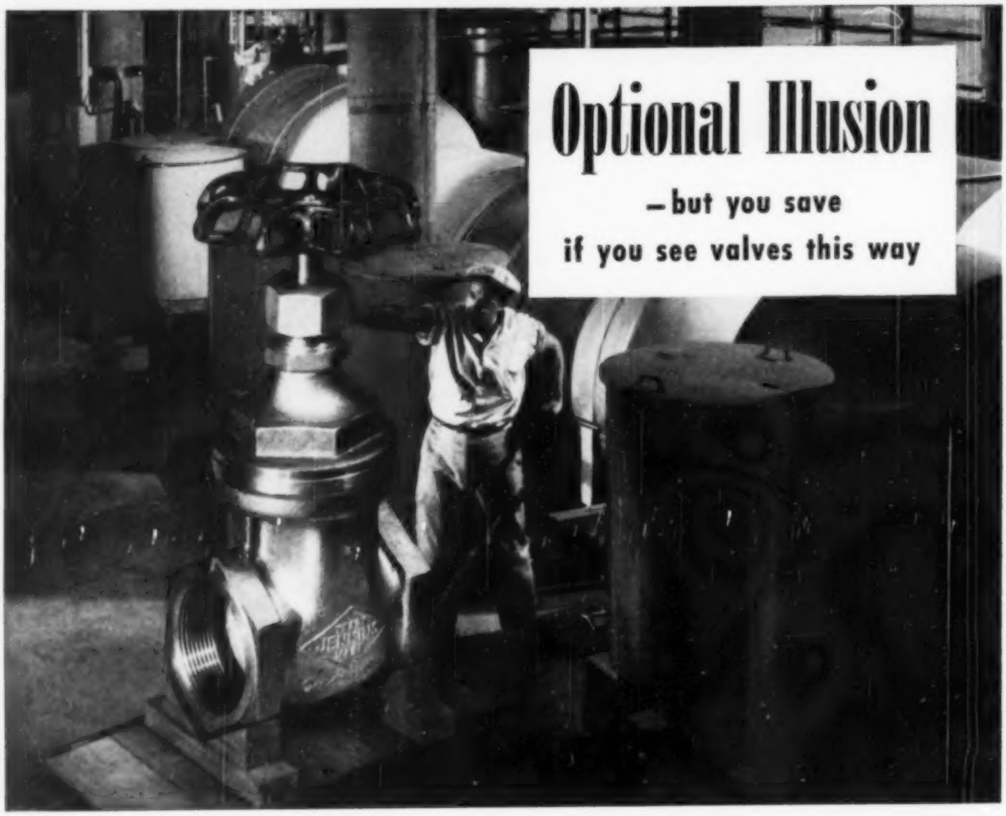
VALVES



THERE ARE TWO WAYS of regarding the valves in your plant. You can think of the relatively small cost of a single valve, and dismiss them as a minor, "petty cash" investment. Or, you can think of *all* valves in your plant as *one* valve, as pictured, by photo-magic, in this pharmaceutical plant, — and see them in proper perspective.

YOU'LL FIND IT PAYS to take the latter view, for in *any* plant, *any* building where fluid control is involved, valves, collectively, are as important, in terms of investment and operating expense, as larger plant units, and should be selected with the same sharp eye to quality and economy.

EXCESSIVE MAINTENANCE of one inferior valve is insignificant, but multiplied by thousands, it is a serious drain on operating budgets. JENKINS BROS. helps you meet this problem two ways. First, by building extra endurance into Jenkins Valves, making them the longest-lasting, lowest-upkeep valves that money can buy. Second, with advice from Jenkins Engineers on any question of proper selection, installation, or maintenance.

For all new installations, for all replacements, rely on Jenkins quality and engineering for lowest valve costs in the long run. *Sold through leading Industrial Distributors.*

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"PRACTICAL PIPING LAYOUTS" is a 32-page book containing diagrams and descriptions of 25 basic piping layouts with complete recommendations for valve selection and location in the lines. Tells you "which valve where for best performance". FREE on request. Write JENKINS BROS., 80 White Street, New York 13, N. Y.

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Types, Sizes, Pressures, Metals for Every Need

MUDDLING in High Places

It is time for men in Washington and London to stop toying with the problem of international trade. We of the democratic West are at a turning point in our economic affairs. A false step by either the United States or Britain could lead quickly to disintegration of trading between the people of the world as we have known it for the past hundred years. Recent meetings of diplomats in London and Washington have not lifted us out of this danger.

By two simple tests you and I can measure the sincerity of the men in Washington and in London who are trying to solve what they call "the dollar crisis."

One test applies to the British: Is Britain making an honest effort to re-establish itself as a real competitor in world markets?

The other test applies to us in the United States: Are we willing to see Britain re-emerge as a strong competitor in world markets—even in our own home market—and to help her do so?

Today, even though both countries have faced the devaluation test, the answer to these questions probably is no.

I

The situation we face is, in fact, unprecedented. In every important industrial country of the non-Communist world, except Germany and Japan, production is above prewar volume, thanks largely to the Marshall Plan. Yet trade between nations is shackled as it has never been since the 18th century. And the shackles grow day by day. What is worse, two distinct trading areas—the dollar area and the sterling area—have grown up in the non-Communist world, and the gulf between them grows wider.

What kind of leadership have the United States and Britain had in the face of this crisis? President Truman late in August wisely checked the trans-Atlantic bickering over the dollar crisis. *But Mr. Truman showed no awareness of the basic question that the American people must soon decide: Is the United States able and willing to generate trade between nations, as Britain did in the 19th century?*

What have British leaders offered us? Foreign Secretary Bevin and Chancellor Cripps called their September visit to Washington "one of the most important missions in history." *But they did not tell the British people, and perhaps do not admit themselves, that their Labor government must change its internal and external policies if Britain is ever to earn its living in a competitive world.*

Admittedly, the problem Britain has faced since 1945 is a colossal one. But, in the face of its grave difficulties, what has Britain done? The working day was shortened. Welfare economics have run riot. High taxes have sapped incentives. Labor and capital have clung to their prewar psychology of cartels and featherbedding. Government controls and government trading have hamstrung private initiative. Nationalization schemes have injected politics into the struggle for industrial recovery.

Thus the policies of the Labor government have made Britain's adjustment to its new position in the world immensely more difficult. But Americans who attribute the danger of an international breakdown to British socialism greatly oversimplify the problem. Virtually every country in the world, socialist or not, faces the same dollar crisis that Britain faces.

continued on next page

We Americans must recognize that our economic strength unbalances world trade as does Britain's weakness. World War II increased America's superior power to produce goods. It also made the United States more self-sufficient. Thus, while the world demand for American goods has risen, our demand for foreign goods, except for basic raw materials, has not increased. Today we sell more to every major area of the world than we buy from it—and yet we wonder why there is a dollar crisis.

It is time for us to recognize that there are two fundamentally conflicting pressures at work in the United States. One is our desire for a big surplus of exports over imports. The other is our desire for a system of free-wheeling trade around the world. We can not have both unless we as taxpayers wish to subsidize our exports. Which do we want?

Curtis E. Calder, chairman of the International Relations Committee of the National Association of Manufacturers, says, "The battle of the foreign trade gap is essentially that of reconciling our urge to export our surpluses with a reluctance to accept imports in payment for them . . . The dilemma is an uncomfortable one to face."

II

Here, then, are the basic questions that confront men in Washington and London. Does Britain really want expanding world trade or a high-cost welfare state? Does the United States really want expanding world trade or a huge surplus of exports? So far politicians in Washington and especially in London have ducked these issues because they are political dynamite.

If the people of Britain decide they want to regain their position as a competitive trader in expanding world markets, here are specific objectives that men in London should set for themselves:

1. Lower government costs. The British Treasury has asked for cuts of 5% in 1950. But a cut nearer 15% will be necessary, even if that means fewer government subsidies and health services. Enterprise will never revive nor costs come down while taxes take 40% of the British national income, including roughly 60% of business profits.

2. Fewer government controls. Only by removing controls and allocations (except on a few necessities) can Britain begin to return to prices fixed by competition rather than by government fiat.

3. Stronger anti-monopoly legislation for both business and labor. Britain needs a concerted drive against all forms of restrictive, high-cost practices. This drive should put teeth in the anti-monopoly act and supplement it with legislation to end restrictions imposed by trade unions.

4. Less restrictive trading practices. Britain should retreat gradually from its international barter between governments if competition is ever to have free play in international trade.

Meanwhile, if we of the United States sincerely want multilateral world trade, men in Washington must face up to four problems and hammer out workable solutions:

1. Use of the International Monetary Fund to back a devalued pound. In time the Fund, in which we have the controlling voice, might be used to promote convertibility of pounds into dollars.

2. Help for Britain in meeting war-created external debts. This might mean support for London in getting a reduction of the war debts Britain owes India, Pakistan and Egypt, for example. To achieve such a debt reduction for Britain we might have to underwrite a part of a Southeast Asia recovery program.

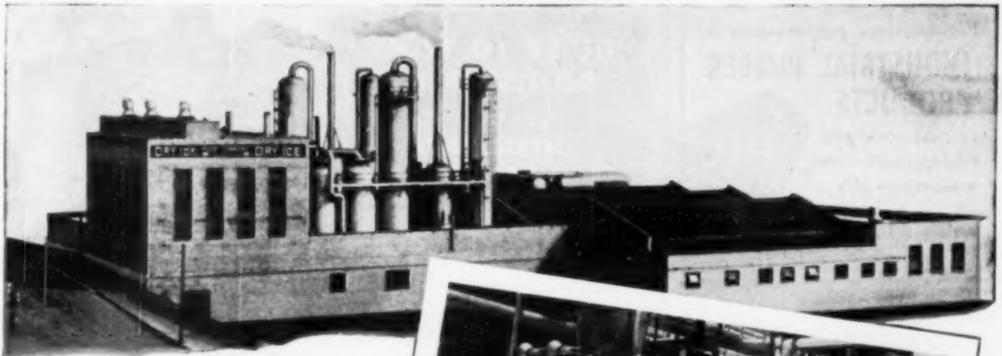
3. Encouragement of American investments abroad. Such investments should be directed primarily into enterprises which will earn dollars, such as the development of new sources of raw materials, or which will raise productivity abroad.

4. Our own tariff barriers. Our attitude toward this critical issue will be the acid test of how deeply we believe in the merits of free world competition.

If we really want free, competitive trading between the people of the world, these issues must be met and resolved by leaders on both sides of the Atlantic. If we do not want to face these issues, then let us resign ourselves to a world walled off into three trading areas: the Communist bloc, the sterling area, and the dollar area. So far, Washington and London have muddled along, except in facing the devaluation problem. Clarity and courage are still needed.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.



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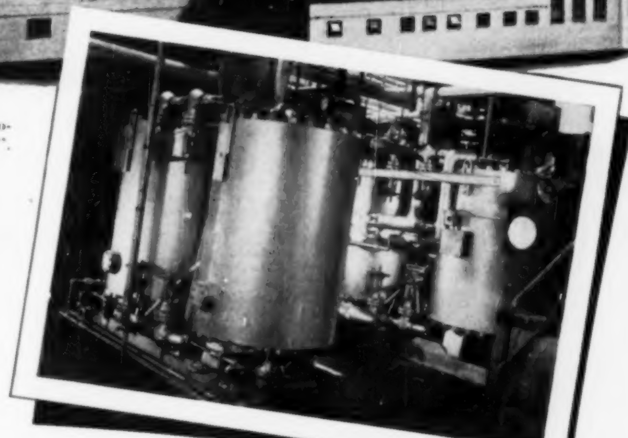

These Type BWC-1500 Lectrodryers, built to operate at 600 psi., DRY the carbon dioxide. Lectrofilters remove oil vapor as the gas comes from the compressors.

dried DRY by Lectrodryers

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Pure Carbonic, Incorporated, has been using Lectrodryer equipment for many years in all their plants. Their operating men report "excellent performance and minimum maintenance."

DRYing air, gases and organic liquids is helping thousands of companies boost product quality and hold it high. Reactions stay "on the beam" when you're working with materials of known moisture content. Products do not suffer deterioration when stored in DRY atmospheres. DRYing is speeding up production by permitting materials to flow freely.

May we show you what DRYing will do for you? Write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Penna.

See our *Automatic Instrument-Air Dryer* at the booth of The Jack-Stiehl Company, Lectrodryer representative, if you're attending the Pacific Chemical Exposition, November 1-5 at the Civic Auditorium, San Francisco.

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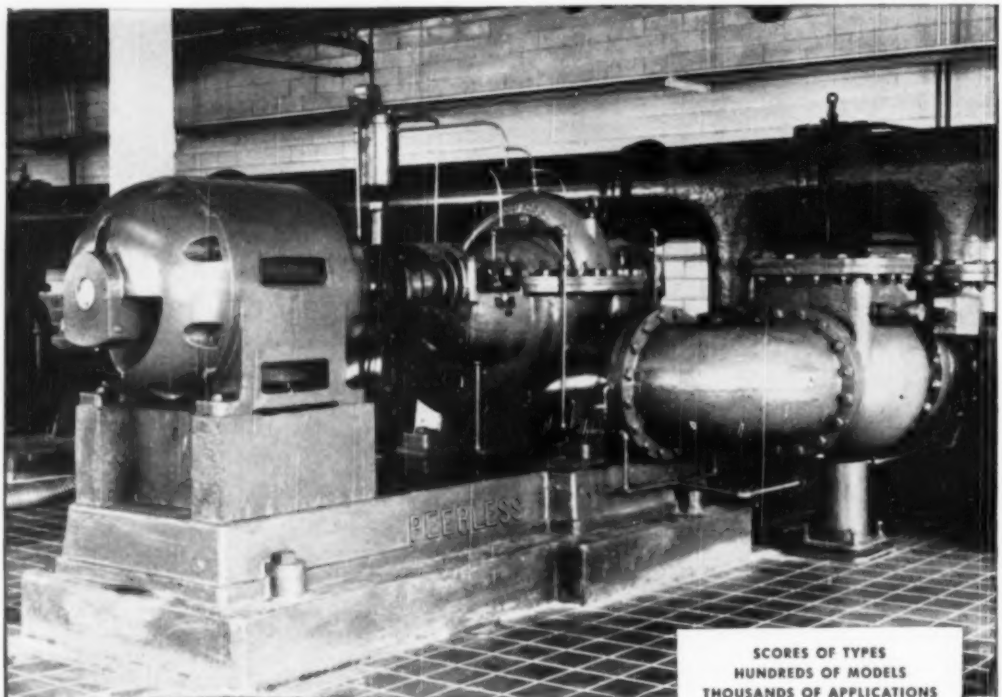
PEERLESS HORIZONTAL CENTRIFUGAL PUMPS



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For continuous or intermittent duty in a host of diversified services

Select the pump you need for the process you use from the diversified line of Peerless horizontal pumps. The pump shown above, a Peerless general purpose pump handling plant process water, typifies a host of efficient Peerless centrifugal pumps which are boosting output and cutting costs for manufacturers and municipalities everywhere. With its comprehensive line of horizontal pumps Peerless can handle chemicals or alkaline liquids, pump clear water or solids in suspension. There are pumps for fluids at high temperatures or they can furnish water or foam for approved plant fire protection. Peerless will move volatile butane-propane or tricky caustics and acids. Pumps are available for all practicable heads and capacities. Duty can be continuous or intermittent. Construction materials are suited to the liquid being pumped. And, backing up their installation qualified Peerless field engineering service is available in all principal cities to see that each pump matches or exceeds customer expectations. Write today for pump engineering information on your process or service. The chart at right lists a number of the types of Peerless horizontal centrifugal pump bulletins in which you will be interested.

fmc

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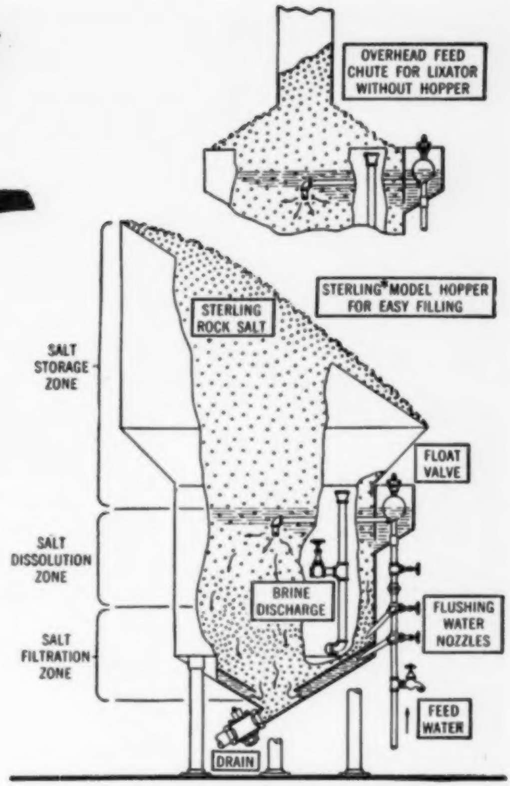
Brings Maximum Efficiency at Lower Cost to Brine Production



The Stainless Steel Sterling Model Lixator is the last word in brine production. This model Lixator provides added money-saving improvements that mean *still lower brine production costs.*

Stainless Steel Construction for "Lifetime" Use

Improved Cleanout System

Lowered Storage Hopper for Easier Filling

Added Cleanliness

The Sterling Model Lixator is manufactured in standard sizes ranging in capacity from 50 to 425 gallons of brine per hour.

Why not consult us about your brine problems? The specialists in our Technical Service Department are available for free consultation. These experienced men will advise you on the proper location for Lixator and salt storage, pumping arrangements, types of pumps, meters and valves. They will show you how the new Sterling Model stainless steel Lixator *means bigger profits for you.* Write today!

WHAT THE LIXATOR PROVIDES

Chemical and bacterial purity to meet the most exacting standards for brine.
Unvarying salt content of 2.65 pounds per gallon of brine.
Crystal-clear brine.
Continuous supply of brine.
Automatic salt and water feed to Lixator.
Inexpensive, rapid distribution of brine to points of use by pump and piping.

PLUS THESE PRODUCTION SAVINGS

- **Ends hauling salt around the plant.**
- **Saves time wasted in making brine.**
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The **LIXATE** *Process*
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for making brine

INTERNATIONAL SALT COMPANY, INC.
Scranton, Pa.

*Trade Mark

POLYTHENE-LINED PAPER BAG PROTECTS MOISTURE-SENSITIVE GLUE

Multiwall bag with a polythene-coated ply has improved resistance to atmospheric moisture over a wide range of temperatures...plus many other advantages

WHEN The Borden Company needed an economical, damp-proof package for a very hygroscopic powdered resin glue, they chose a sturdy, lightweight, inexpensive multiwall paper bag, one layer of which has a thin coating of Du Pont polythene plastic. These bags keep moisture out during handling and shipping, protect contents until used. Compared with many other types of containers, the empty bags save up to 91% of storage space—save shipping costs, too.

The use of paper coated with Du Pont polythene in multiwall bags provides these advantages:

- **better protection against moisture**
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- **better grease resistance**

These characteristics are retained over a wide range of temperatures. The use of a polythene-coated ply also offers greater versatility, since film thickness can be varied to meet specific requirements.

Many other "hard-to-pack" products are being successfully shipped in these bags, including calcium chloride, dry milk, meat trimmings, sodium bisulfite, benzene hexachloride, quicklime, various synthetic resins.

The multiwall bag is only one of many new packaging applications of polythene. The new coating technique used here is a joint development of St. Regis and Du Pont technical men. Du Pont representatives will gladly work with extruders, molders, or converters, or will suggest suppliers who can meet specific needs for packaging or other uses of plastics. Write today for free literature on polythene and other versatile Du Pont plastics.

(Multiwall bag made by St. Regis Paper Co., New York, New York.)

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every year the power savings grow greater

with DE LAVAL Labyrinth Wearing Rings

Here's the reason why

Assume that two pumps attain the same efficiency when new. One is equipped with ordinary close clearance, flat rings at the running joint between impeller and casing; the other with large clearance labyrinth rings.

As wear increases the clearance between the rings, the efficiency of the pump equipped with flat rings drops off more rapidly than that of the labyrinth ring pump because the flow retarding action of the flat rings depends solely upon the maintenance of close clearances; while the flow retarding action of the labyrinth rings is due to the resistance of a labyrinth passage.

The longer the pumps are used, the greater the difference in leakage, the greater the difference in efficiency and the greater the saving due to the use of De Laval labyrinth wearing rings. Every year the power savings grow greater

When selecting a pump consult the rating tables in De Laval Catalog 10-15-M.

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DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

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CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

10-15


their LONG LIFE makes
LAPP PORCELAIN RASCHIG RINGS
the most economical tower packing you can buy
THE cost of packing for chemical towers must be based on original cost of the packing against length of service, plus labor cost for cleaning and repacking, and lost production time. Because they are stronger and smoother, Lapp Porcelain Raschig Rings last longer . . . they are the most economical ceramic rings you can buy.
STRONGER, NON-POROUS PORCELAIN. Lapp Raschig Rings are made of solid Lapp Chemical Porcelain, a dense, thoroughly vitrified, pure, iron-free ceramic material of zero porosity . . . permits no absorption of liquids so avoids disintegration and crumbling.
SMOOTHER SURFACE. Without benefit of glazing, Lapp Porcelain is hard and smooth, easy to clean—and stays clean longer.
Lapp Rings are available in 3/8", 1/2", 5/8", 3/4", 1", 1 1/4", 1 1/2", 2" and 3" sizes. Write for detailed description, prices, samples. Lapp Insulator Company, Inc., Process Equipment Div., 110 Maple St., LeRoy, N. Y.
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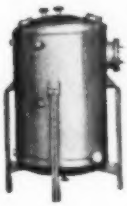
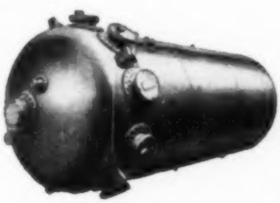
The "vessels" used in the process industries may range from a five-gallon receptacle to a cavernous tank. Details of construction may differ. But, when it comes to handling corrosive chemicals, much of this equipment has at least one thing in common . . . a lining of lead. Because *Lead blunts the teeth of hungry acids.*

Leaders in the chemical processing field have something in common, too. They rely on the leader in lead products . . . National Lead . . . for their lead-lined and lead-covered equipment. They know that National offers . . . *and delivers* . . . not merely a mass of metal bearing outward resemblance to drawing and blueprint, but a piece of acid-handling apparatus that has the built-in ability to do the job it was bought to do. Into each unit goes the know-how, from drafting board to shop assembly, that makes the most of lead's resistance to chemical attack plus steel's resistance to physical abuse.



In National Lead's "Homogeneous" lead-lined tanks, drums, agitators, autoclaves and other items of this nature, the lead lining is bonded directly to the steel casing. An inseparable bond is created, a union of lead and steel that obviously will withstand higher temperatures than one in which solder is used.

Every piece of National Lead's "Homogeneous" lead-lined and lead-covered equipment is individually fabricated to your specifications. When you want information on acid-handling apparatus, please consider our specialists in this field *at your service.*



Look to the Leader for Lead

...in everything from lead pipe...valves...sheet...and lead-lined or lead-covered equipment...to complete acid recovery plants

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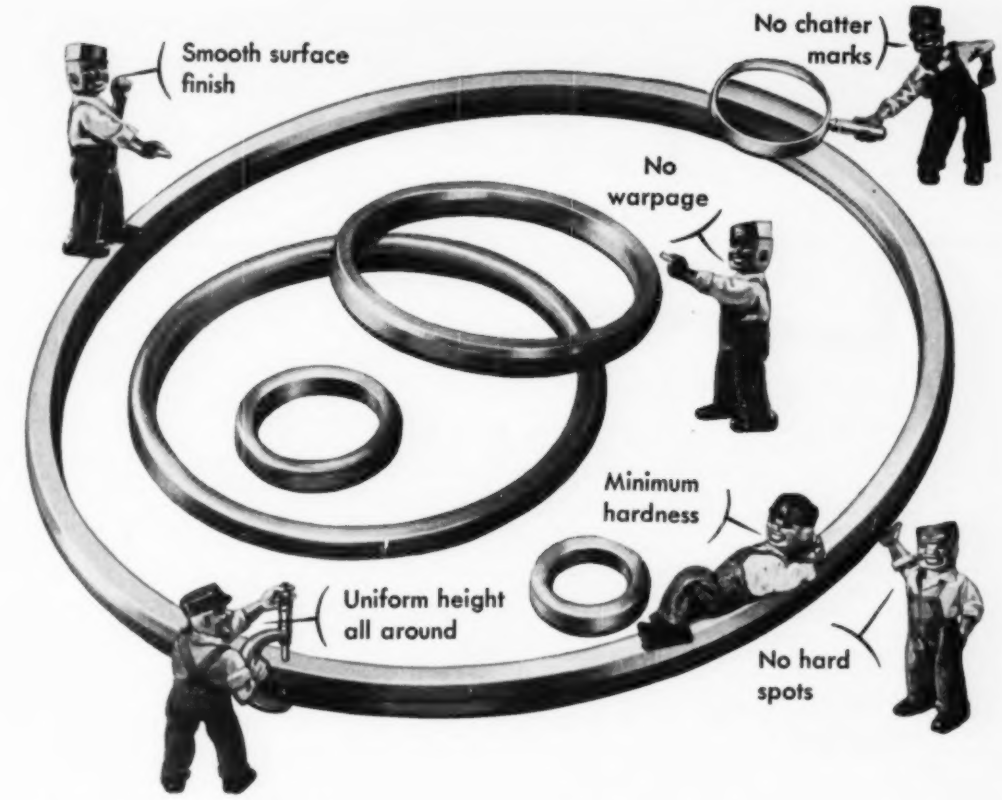
ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all standard sizes, fits all standard grooves. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.



Made "soft" for proper flow ... Made accurate for perfect fit!

Goetze V-Tite Gaskets for ring-type joint flanges

One sure way to tell quality in a gasket designed for ring-joint flanges is to check the hardness. In Goetze V-Tites, carefully controlled heat treatment during fabrication keeps hardness down to a minimum. The hardness of a Goetze soft iron V-Tite Gasket, for example, does not exceed 90 Brinell.

And because each gasket is uniformly "soft" throughout (you'll find no hard spots in a Goetze V-Tite), proper flow or seating of the gasket, without damage to flange surfaces and with minimum bolt stresses, is always assured.

Dimensional accuracy is also important in a ring-type gasket. Here, too, Goetze V-Tites meet high precision standards. They are of uniform height all around ... free of warpage ... have the same center-to-center measurements top and bottom ... other tolerances are well within API and ASA specifications to assure a perfect fit in the flange grooves.

In addition to soft iron, Goetze V-Tite Gaskets are made in a number of alloys in all standard ASA and API shapes and sizes. Gaskets of special dimensions are also available. For further details, write for Catalog PK-35A. Johns-Manville, Box 290, New York 16, N. Y.

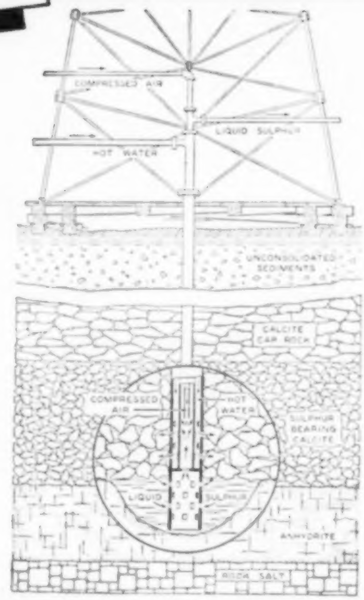
Johns-Manville Goetze Gaskets

THERE'S A JOHNS-MANVILLE PACKING OR GASKET FOR EVERY SERVICE

SULPHUR

***Interesting Facts Concerning This Basic Raw Material from the Gulf Coast Region**

*WELL PIPING



The well equipment consists of pipes of various sizes, placed one within the other and extending from the surface into the sulphur deposit. A 10" or an 8" casing extends to and rests on the top of the cap rock. A 6" pipe, inside the casing, passes below it and reaches into the barren anhydrite. It is perforated at two different levels, separated by an annular collar. The upper set of perforations permits the hot water to enter the sulphur formation and the lower set permits the entrance of the molten sulphur to the discharge pipe fitted inside the 6" pipe.

When a well is "steamed" the hot water passes down the annular space inside the 6" pipe and outside the sulphur pipe and flows through the upper set of perforations into the porous formation. The entire mass through which the hot water circulates is raised to a temperature above the melting point of sulphur. The liquid sulphur being heavier than water, makes its way downward to form a pool and displaces water around the foot of the well, and rises in the well column through the lower perforations into a 3" pipe which is the sulphur discharge pipe. Compressed air released at the bottom of still another pipe fitted inside the 3" pipe rises and mixes with the sulphur column, forming an air lift which raises the liquid sulphur free of water to the surface.

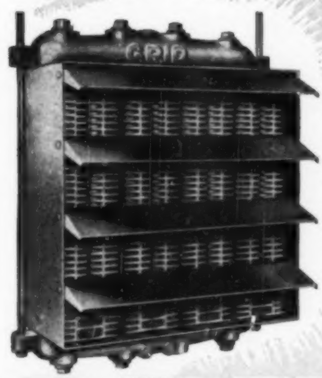
Loading operations at one of the huge vats of Sulphur at our Newgulf, Texas mine. Such mountains of Sulphur are constantly being built at our mines, from which shipments are continually made.

TEXAS GULF SULPHUR CO. INC.

75 East 45th St. New York 17, N. Y.

Mines: Newgulf and Moss Bluff, Texas

YOUR OWN INDUSTRY SAYS



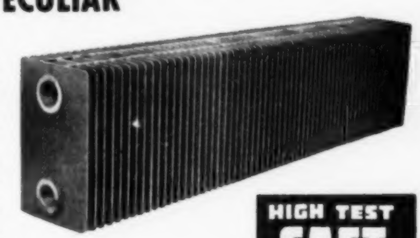
Gentlemen:
The first GRID Unit Heaters were installed by us eight years ago. We have found the cast iron construction stands up very well against the corrosive fumes of HCl., Cl_2 etc., and as far as we know there has not been any maintenance on the units. The unit heaters having copper tubes gives trouble due to corrosion in a few years... We consider the GRID Unit Heaters satisfactory and would certainly recommend them for installation where corrosive acid fumes exist.

Yours truly,

A LARGE EASTERN CHEMICAL PLANT

GRID *Equipment*

WILL STAND UP UNDER CONDITIONS PECULIAR TO THE CHEMICAL INDUSTRY



Not only do GRID Unit Heaters stand up against the corrosive fumes of HCl and Cl_2, but even in that service they are maintenance-free. Chemical plants that have used GRID Unit Heaters continuously since 1931 report "they have given us trouble-free heating service ever since the day they were installed," and this season they still did an efficient heating job. Why this long continuous service to the chemical industry?

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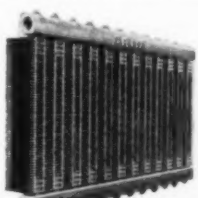

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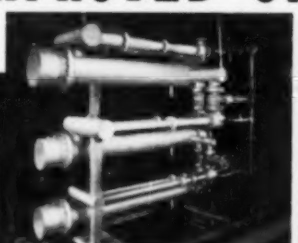

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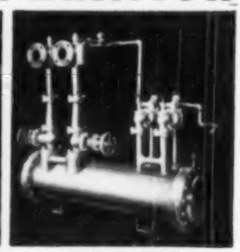

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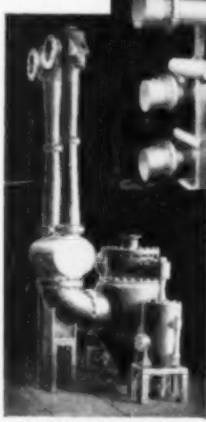

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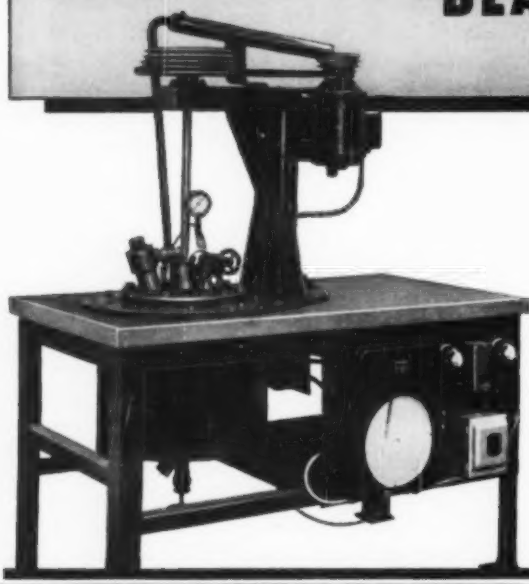

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physical structure

average permeability of dry plate, cu ft/min/sq ft/in. thick./at 2 in. water pressure	average modulus of rupture, psi		breaking load when wet plate is supported on four sides with ½-in. bearing	
	dry	wet	ft of water	# / sq. in.
121.0	1670	1465	97	42
80.9	1950	1685	110	48
37.8	2684	2235	147	64
16.9	3045	2644	175	76
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AND BE SURE OF VALUE, QUALITY, PERFORMANCE

Underwood & Underwood

THE GELB GIRL—OCTOBER, 1949

1—Sperry 24" Stainless Steel Filter Press, Closed Delivery, 12 chambers with Hydraulic Closing.
1—Shriver Stainless Steel Closed Delivery Filter Press, 12", 7 jacketed chambers.
1—Shriver 42" x 42" Filter Press, 46 chambers with hydraulic closing.
1—Shriver 36" x 36" Filter Press, closed delivery.
1—Sperry Plate & Frame Aluminum Filter Press, 18" x 18".
1—Shriver bronze plate & frame Filter Press, 18" x 18".
2—Sweetland #5 Stainless Steel Filters (New).
1—Vallez #3 Filter.
1—Sperry Rubber-lined Filter Press, 12" x 12", closed delivery, Plate & Frame.

1—Pfaudler 60 gallon glass-lined reactor, with agitator and glass-lined condenser.
2—Pfaudler 50 gallon glass-lined stills.
1—Pfaudler glass lined 5-gallon still.
1—Pfaudler glass lined jacketed kettle, 5 gallons.
1—Glascote jacketed glass lined kettle, 350 gallons.
1—Glascote jacketed glass lined kettle, 50 gallons.
1—Pfaudler aluminum jacketed reactor with agitator, 1300 gallons. (New)
1—Pfaudler aluminum jacketed reactor with agitator, 250 gallons. (New)
2—Pfaudler 500 gallon glass lined storage tanks. (Horizontal)

1—Banbury Mixer #1 with 50 HP Motor.
1—J. H. Day double arm, jacketed mixer, sigma blades, 500 gallons.
1—Baker Perkins double arm jacketed Mixer, 2000 gallons.
3—J. H. Day double arm jacketed mixers, 50 gals., sigma blades.
1—Baker Perkins double arm jacketed mixer, 200 gals. sigma blades.
5—Baker Perkins double arm mixers, 200 gals. sigma blades.
1—J. H. Day Mogul type Mixer, 5 gallons.
5—Simpson #0 Intensive Mixers.
1—Baker Perkins jacketed lab. mixer, Size 6, Stainless Steel.
1—J. H. Day Lab. Type Mixer.
1—Bird Suspended type Centrifuge, 40" Stainless Steel perforated basket with motor.
1—Tolhurst Suspended type Centrifuge 40" rubber perforated basket, with motor.
1—Tolhurst center slung Centrifuge 30" rubber basket, with motor.
1—Tolhurst solid curb centrifuge 20" rubber basket, with motor.
1—Podbielniak Stainless Steel Centrifugal Extractor, Model 4080.
10—Sharples Super Pressurite Centrifuges, with 3 HP Expl. proof motors.
1—Sharples Super Pressurite Centrifuge, Stainless Steel Bowl, Model 18 V.
1—EEMCO 2 roll lab. Mill, 6" x 12", with Reeves drive and motor.
1—Royle #1 Prefected Extruder, with heating unit.
1—Allis Chalmers Ball Mill, 5'8" x 18', Silex lined.
3—Hardinge Conical Ball Mills, 8' x 30", 5' x 22" Steel Jacketed.
1—Kettle 300 gallons, with Mixer (ASME).
1—Plate Fabricator, jacketed kettle, 900 gals., 125 PSI (ASME).
1—Steel Jacketed Kettle, 7'3" x 7'.
1—Cast Iron Jacketed Kettle, 300 gallons.

1—Buffalo Cast Iron Jacketed Kettle, 600 gallons, with mixer.
1—Blaw-Knox Jacketed Autoclave, 3' x 4'2", with agitator.
2—Rubber-lined Storage Tanks, 7,800 gallons.
1—Steel Storage Tank, 21,000 gallons.
1—Nickle Jacketed Still, 4' x 5'.
1—Stainless Steel Direct Fire Still, 6" x 6", with coils and agitator.
5—Monel Storage Tanks, 1800 gallons.
1—Steel Storage Tank, 10,000 gallons, 1" plate.
1—Shriver 42" Skeleton.
1—Sparkler filter, Model 18-D-8.
4—Shriver Plate & Frame Lab. Filter Presses, 7" x 7".
2—Steel Pressure Tanks, 4' x 11', 200 PSI.
1—Stainless Steel Tank, 10' x 20'.
2—Black & Clawson Double Drum Dryers, 28" x 5'.
3—Louisville Rotary Steam Tube Dryers, 6' x 50'.
1—Louisville Rotary Steam Tube Dryer, 54" x 30'.
2—Buffalo Double Door Vacuum Shelf Dryers, 12 & 14 shelves.
1—Buffalo Single Door Vacuum Shelf Dryer, 17 shelves.
1—Bartlet & Snow direct fired kiln, 8½' x 50'.
1—Ruggles Cole direct fire kiln, 7' x 60'.
3—Buffalo Flakers, 5' x 12'.
1—Buffalo Double Drum Dryer, 36" x 72", chrome plated drums.
1—Fuller Air Compressor, Model #300.
1—Micro Pulverizer #2TH.
1—Micro Pulverizer #1SH.
1—Fitzpatrick Style D Comminuting Machine.
1—Ball & Jewell Rotary Cutter, #½.
1—Ball & Jewell Rotary Cutter, #2.

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1—6' x 4' Oliver all Stainless Steel Top Feed Rotary Continuous Vacuum Filter. UNUSED. Never installed. Intended to filter ammonium sulphate.

2—#12 Sweetland Pressure Filters drilled on 2" and 4" centers.

5—Foote Bros. Type 8HGV Worm Reducers, Ratio 6.33-1, with or without 10 HP 3/60/220-440V, 1750 RPM Motors.

1—8' x 125' Reeves Rotary Kiln.

1—2' x 15' Rotary Kiln, experimental, complete.

2—6' x 12' Allis Chalmers Rod Mills.

1—#4 TH Mikro Pulverizer Rebuilt—available for immediate shipment.

2—200 Gal. Patterson Pebble Mills, 4'x5', Burrstone lined with drives and motor.

1—Double Shell Direct Fired Rotary Dryer, inner shell 5'6" dia. x 59' long, outer shell 10' dia. x 40'6" long. Complete with motor drive, Oil burning equipment, Instruments and Accessories.

1—Louisville Rotary Steam Tube Dryer 6' x 50'.

1—Rotary Vacuum Dryer 5' x 33'.

1—Vacuum Shelf Dryer, 17 Shelves, 40' x 43".

3—7500 gal. Closed Steel Kettles, 10' dia. x 12'6" deep, with Copper Coils, Closed. Bronze Propeller Agitators, Enclosed Motor Driven Worm Gear Drives.

5—Modern Engineering Co. RVD8 Enclosed Worm Reducers, Ratio 6.43-1, with or without 10 HP 3/60/220-440V 1750 RPM Motors.

Large assortment Nordstrom & ACF Plug Cocks, 2" to 10".

2—Baker Perkins Mixers, Size 17, Jacketed, 200 gal.

1—Buffalo all lead Single Effect Evaporator, 200 sq. ft., with all accessories.

1—600 sq. ft. all copper Single Effect Evaporator or Calandria Pan with Barometric Condenser, Jet Ejector and all accessories.

3—36" x 36" Sperry 60 plate Filter Presses, cast iron, recessed, center feed, open delivery, hydraulic closing, including individual motor driven hydraulic pumps.

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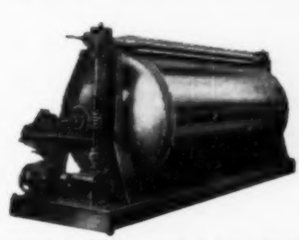
SPECIAL: W. & P. style heavy duty double arm, jacketed Mixers, geared at both ends; 100 gal. working capacity; this month only, $1950

SPECIAL: Philadelphia Gear Reduction Drives with fully enclosed motors 2.67 H.P. (20.1 to 1 ratio) 3/60/440V-87 RPM and 29 RPM. Type VC size 2225 . . . this month only $250.



SPECIAL: Struthers Wells Stainless Steel Drum Dryers size 5' x 10' with auxiliaries . . . for flaking . . . dehydrating . . . this month only $6000.

UNUSUAL EQUIPMENT at LESS than HALF PRICE

Stainless Steel Jacketed Vacuum Pan 4' x 5'
3 Stainless Steel Pressure Vessels; 3' x 5', 4' x 5' and 5' x 8'
Stainless Steel Still 51" x 58" with accessories
Bartlett & Snow Stainless Pan Dryer 7'10" x 2'11"
3 Stainless 5000 Gal. Closed Top, dished manhole style BRAND NEW Tanks; 10' x 7'9"
3 Stainless Open Top Jacketed Tanks; 880 gal., 65" x 68"
Stainless Steel Resin Still 8' x 7'; agitated; coil heated Jacketed Agitated Hi-Pressure Autoclaves
3500 Gal. 6' x 21' 300 PSI
250 Gal. 4' x 5' 350 PSI
50 Gal. 2' x 2½' 350 PSI
Steel Sulphonator 7' x 7½'; Jacketed and Agitated
5 Steel Fusion Pots 4' x 3' with anchor type agitators
4 BRAND NEW 1600 Gal. Vertical Vacuum and Pressure Tanks 66" x 120"
2 Pfaudler Glass Lined Vacuum Pans; 500 gal. and 2500 Gal.
Copper Rectifying Column by Vulcan, 24" x 36' with 50 plates each plate having 10 bubble cups
Forced Circulation Evaporators with Inconel and Karbate Heat Exchangers and accessories (1270 sq. ft.) and (1100 sq. ft.)
2 A. O. Smith Rotary Vacuum Dryers 7'6" x 20' with auxiliaries
BRAND NEW Devine 4' x 12' Rotary Vacuum Dryer
Stokes Nickel Rotary Vacuum Dryer 3' x 5'
2 Struthers Wells Stainless Steel Drum Dryers or Flakers 5' x 10'
Buflovak Double Drum Dryer 32" x 72" with 5 H.P. motor and auxiliaries
2 Proctor & Schwartz Conveyor Type Dryers, 78' and 102'
6 Louisville Steam Tube Dryers from 5' x 25' to 6' x 50'
4 Louisville Screw Type Dewatering Presses
3 BRAND NEW Sperry 42" Aluminum Filter Presses, 34 chamber
6 Cast Iron 36" Plate & Frame Filter Presses; 45 chambers
7 Devine and Stokes Vacuum Chamber Dryers from Lab. size to Double Door Model No. 23, some with auxiliaries
Pittsburg Lectro Dryer No. 250
Kent, Ross & Day Three Roller Mills 12" x 30" and 16" x 40"
Farrell Birmingham Rubber Mills from 24" to 84"
Farrell 3 Roll Calendar 18" x 54" complete with accessories
Heavy Duty Double Arm Jacketed Mixers; 15 to 150 gal. geared both ends
Jacketed Double Ribbon Crystallizer; 28" x 42" x 16'
Readco Jacketed Very Heavy Duty Double Ribbon Mixer; 30" x 33" x 68"
Wolfe 5000 lb. Double Ribbon Mixer; 50" x 54" x 114" long
3 Porter 370 cu. ft. Double Ribbon Mixers; 5½' x 5' x 16' motorized
J. H. Day Ro-Ball Sifters; 2 or 3 separations; 40" x 120"
8 Copper and Steel Evaporators with copper tubes; Diameters from 5½' to 10'8" and overall height from 12' to 21'
10 Stainless Steel Centrifugal Extractors from 12" to 60"
2 Buhrstone Lined Pebble Mills, 4' x 5' and 6' x 5'
2 Patterson Chrome Manganese Lined Ball Mills; both jacketed sizes 5' x 6' and 5' x 16'

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2 Louisville Steam Tube Dryers 5' x 25'.
4 Louisville Screw Type Dewatering Presses.
5 Sterling Boilers 275 HP to 512 HP.
2 Jones Stokers.
5 Steel Grain Tanks 9½' x 9½', 11' x 7'.
8 Steel Cook Tanks, Jktd. and Agitated, from 5' x 5' to 9½' x 18'.

6 Copper and Steel EVAPORATORS
Single, Double and Triple Effect
5'6" x 12'—486 tubes.
9'4" x 18'—1612 tubes.
7' x 16'10"—1712 tubes.
10'8" x 21'—2400 tubes.
7'11" x 17'6"—1734 tubes.

6 Heavy Copper Tanks from 2,000 to 6,000 gal.
Bauer 36" Attrition Mill with two 50 H.P. motors.
2 Filter Tubs, 12'—18' dia.
3 Grain Mills, 9" x 24"—40".
Fairbanks and Howes Hopper Scales from 10 ton to 30 ton.
Large quantity of Screw Conveyor, Bucket Elevator, Bins, Hoppers, Steam Pumps, Centrifugal Pumps, Vacuum Pumps, Deep Well Pumps, Steam Turbines, Air Compressors, Grain Cleaners, Hop Breakers.
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Miscellaneous Factory Handling Equipment, Motors, etc.

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1—New Pfaudler 500 gal. Glass Lined Jack. Reactor.
1—New Jack. Stainless Steel Reactor, 150 gals.
1—New Glass Lined Jack. Reactor 1,000 gals.
10—New Hubbert 100 gal. Stainless Clad Jack. Kettles.
1—Stokes 30" x 8' Rotary Vacuum Dryer.
1—Ruggles Coles Rotary Steam Tube Dryer, 4'x20'.
2—Rotary Kilns 3' x 12' & 5'-6" x 10'-2".
6—Stainless Steel 40" & 48" Sus. Style Centrifuges.
1—Charlotte Stainless Steel Colloid Mill—20 H.P.
2—Abbe 6' x 8' Buhrstone Lined Mills.
2—Fitzmills Model D Comminuting Mach., S.S. parts with 5 H.P. Motors.
3—Mikro 2TH Pulverizers 10 and 15 H.P. Motors.
10—Horiz. Spiral Mixers, 25 lb. to 3,500 lbs.
4—Vac. Shelf Dryers, Lab. to 20 Shelf.
2—Stainless Steel Tanks 11,000 gals.
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VACUUM MIXER

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1 Day 150 Gal. Brighton Mixer.
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3 Steel Roller ink and Paint Mills. 9" by 25"—12" by 30"—16" by 40".
1 Eppenbach Homo-Mixer.
1 Motor driven portable belt conveyor.
1 W & P Double-Armed Lab. Mixer.
10 8" Premier Colloid Mills, Water-Cooled.

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24"x20" Buflovak Vacuum Drum Dryer.
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100 to 300 gal. S. S. Mix. Tanks, water jkt.
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"Lightnin" Portable Mixers, 1/3 and 1/4 H.P.
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ADVERTISERS IN THIS ISSUE

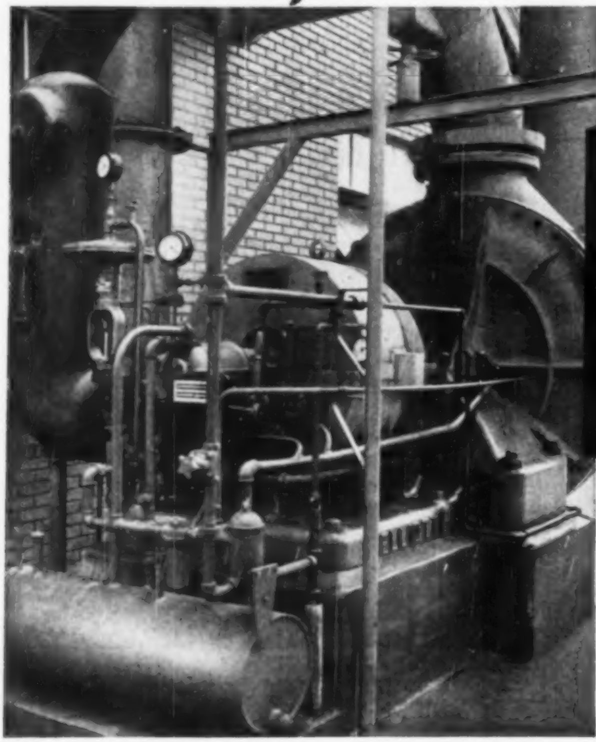
ADVERTISERS IN THIS ISSUE

SEARCHLIGHT SECTION

(Classified Advertising)

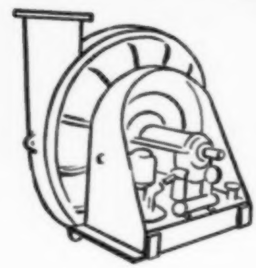
ADVERTISERS INDEX

They meet the ACID *test*



This Elliott single-stage blower in a contact sulphuric acid plant has a capacity of 20,400 inlet cfm and a pressure differential of 100 in. water. Driven by Elliott 375-hp steam turbine. An outdoor installation.

ELLIOTT *Centrifugal* BLOWERS



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As evidence that Elliott blowers fulfill all these requirements, may we point out that they have been selected for the majority of new sulphuric acid plants built over the past twenty years. Further, they have replaced existing blowers in many modernized older plants. An appreciated construction feature is the open type impeller which is self-cleaning and consequently subject to a minimum of corrosion, permitting long periods of operation without the unbalance which so often occurs with closed type impellers. The shaft packing seals against inlet pressure only, thus minimizing leakage of corrosive vapors along the shaft.

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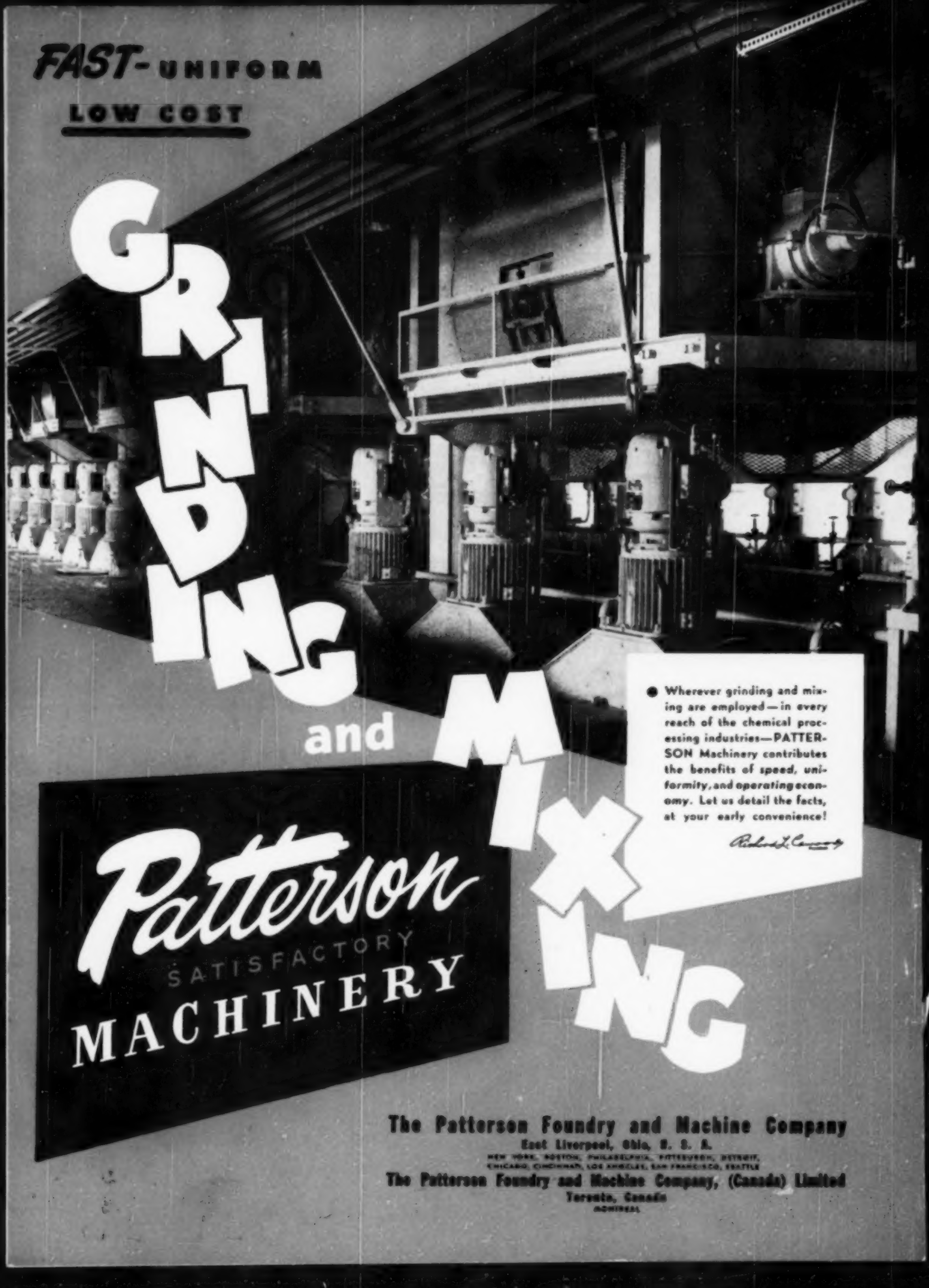
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